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[OFFICIAL NOTICE.]

New England Association of Gas Engineers.

The Annual Meeting of the Association will be held at Young's Hotel, Boston, Mass., on the 15th, 16th and 17th days of February, commencing at 11 o'clock, A.M., on Wednesday, the 15th of said month.

Members intending to propose the names of applicants for membership, are requested to send them to the Secretary, at least two days before the time of meeting.

The Directors will meet in Room 11, on the evening of February 14th, at 8 o'clock. Papers to be read before the Association should be forwarded to the Secretary in time to be presented to the Directors, at this meeting for their approval.

Those wishing rooms engaged will please notify the Secretary on or before February 11th.

GEO. B. NEAL,
Secretary.

BOSTON, Jan. 20, 1882.

OBITUARY.

MR. GEO. DWIGHT, OF SPRINGFIELD, MASS.

With deepest reget we have to announce the death of Mr. George Dwight, of Springfield, Mass. He had not been well for some time, and was contemplating a trip to Florida for a couple of months; but on Friday, the 27th of January he was siezed with a stroke of paralysis, which affected his left side and his throat, and, in spite of all efforts for relief, he expired on the 30th of January.

As a man no word need be said for all who knew him felt that he was one of Nature's noblemen whose only impulse was to do right. As a friend and companion he had few equals. His sound practical judgment, his honesty of purpose, his integrity of action, made him one of those to whom all looked with consideration and confidence in either the emergencies or the practical routine of life.

As a gas manager he was one of the oldest in New England. Ever progressive, there were no actual improvements applicable to the circumstances of his company which were not to be found in his works. Few men in the business were looked up to with such respect reverence and admiration as were accorded to Mr. Dwight by all of his associates and brother managers. His loss will be seriously felt, as it will mark the taking away of another of the noble-hearted, genial and reliable gentlemen of the old school whose connection with the gas interest reaches far back towards its early days. Others may succeed to the places of honor and trust he has filled in the various associations of which he was a member; but none can exactly fill his place in the hearts of those who knew him.

Among the many places of trust and honor which he held may be named the following: President of Springfield Cemetery Association; Superintendent and Engineer of Gas Company. He had served in State Senate and House of Representatives; was Superintendent of the National Armory in 1861, and, for many years, Chief Engineer of the Fire Department; for a long time member of Board of Aldermen, and also a Trustee of the old Institutions for Savings. It was only a short time ago that he declined the honor of President of the New England Association of Gas Engineers. His funeral takes place to-day at 2:30 P.M.

PURCHASE OF WATER GAS PATENTS.

The Knickerbocker Gas Light Company of this city has purchased from the Metropolitan Fuel Gas Company the exclusive rights in the Strong and Lowe patents for the manufacture of fuel and illuminating water gas for the city of New York. This company now owns the Tessie du Motay, the McKenzie, the Strong and the Lowe processes for the manufacture of water gas. The gas at present supplied to its consumers by the Knickerbocker Company is Manufactured by the Municipal Gas Light Company, at its works 44th to 46th streets and North River, from whence it is conveyed to the Knickerbocker works by a direct main about three miles in length. During the past year no gas has been manufactured by the Knickerbocker Company at its works 98th and 99th streets and East river, which have been recently reconstructed and fully equipped for making gas under the Tessie du Motay patents, the same as used with so much success by the Municipal Company. If water gas is what the citizens of New York require, which may be, in our opinion, questionable, it would seem as if the Knickerbocker and Municipal companies together could now supply it of any kind.

We think, however, the Municipal Company, under the process heretofore employed, have accomplished all that can be desired in that direction, and we see no good reason why any change in their method should be made so long as water gas is the article to be produced. What is really needed is some economical method of reducing the large proportion of carbonic oxide contained in water gas, which is undoubtedly a very undesirable element.

As a financial operation there can be no doubt that money has been made by those interested in the Municipal Company; but we do not attribute this to the superiority of any process. Money, good management and proper construction will accomplish much; and, often, a poor plan, persistently adhered to and well carried out is more successful than a better one badly executed.

The early efforts at the first Municipal works were not altogether satisfactory; but, under subsequent management, better results followed. Still we are of the opinion that the success obtained was almost entirely due to the intelligence, skill, and untiring perseverance of those whose mechanical ability was so completely put into the entire reconstruction of works and apparatus, and not to any particular process. Under all the circumstances it may be very good policy to own enough processes to be equal to any emergency.

CONDENSATION OF COAL GAS.

The Gas Institute (formerly British Association of Gas Managers) has started out on a new line of usefulness which must result in much good. At the last annual meeting at Birmingham resolutions were passed directing an enquiry into the "effect of condensation upon the illuminating power of coal gas."

A series of seventeen questions has been prepared and sent to the members by the Council of the Institute which, if fully and carefully answered, will give a large amount of information upon one department of gas manufacture which has been heretofore neglected.

Of course the consideration of this subject, as proposed, must involve the whole matter of condensation. The questions are first directed to the size of works, kinds of coal, quantity of gas per ton, kind of retorts used, amount of tar and kind of dip-seals or anti-dips; and then the enquiry comes to the kind of condenser employed, defining the term condenser "to include all pipes, etc., from the hydraulic forward, to the outlet of the condenser proper."

Here is the very point where most of the trouble from want of proper condensation arises. The tar should never be allowed to pass that outlet; but in too many cases it is found all the way on, even to the purifying boxes.

The enquiry then goes to means of separating the tar and gas, and the effect of prolonging or shortening the contact of the tar and gas on its illuminating power. Then each gas manager is asked to make a definite and simultaneous set of observations, for two given weeks, upon the temperature of the gas, taken three times a day, at outlet and inlet of the condenser proper, together with the illuminating power of the gas in the holders on each of the same days.

The Council are to be congratulated upon the clearness and comprehensiveness of their questions, and the results will be looked forward to with much interest.

Annual Meeting of the Brooklyn Gas Company.

At the annual meeting of this company, held on the 19th of January, the following Directors were elected:

Charles E. Bill, James How, Seymour L. Husted, Peter C. Cornell, Henry D. Polhemus, Henry K. Sheldon, John J. Studwell, Alexander M. White, and James H. Armington. At a meeting of the Board of Directors the following were elected as officers of the company:

President—James H. Armington.

Secretary and Treasurer—Edward Storer.

Mr. Arthur W. Benson, the former president, most absolutely declined to hold the office of president any longer. In May, 1861, he was elected vice-president of the company, and on January 20th, 1862, he was elected president, which office he has held ever since, thus completing twenty years of service. Many have been the changes in Brooklyn gas matters in that time, and in most of them Mr. Benson has taken an active and influential part. And although it was desired to have him remain at the head of the company still longer, he declined, on the ground that other interests and advancing years made it proper that others should take the responsibilities of the office.

The choice of the directors, in selecting Colonel Armington as their head and manager, gives them the advantage of the services of one long familiar with the requirements of the company, thoroughly posted in gas manufacture, and whose uprightness and integrity, genial disposition and conservative judgment will tend to make a most excellent executive. In his hands the interests of the company will be well guarded.

Petrolem for 1881.

Stowell's *Petroleum Reporter* gives the following figures, as furnished by the Bureau of Statistics, regarding the total exports of petroleum from the United States, for the eleven months ending Nov. 30, 1881—

	Gallons.
Crude	37,967,061
Naphthas	19,679,712
Illuminating	403,906,769
Lubricating	4,637,465
Residuum	3,108,840
Total	469,299,847

The money value of which is represented by $44,415,673.

The year 1881 has been significant in the oil business, in giving as low an average price for crude, the largest number of producing wells, the largest average of drilling wells, the highest daily production, and far greater consumption than any one year before—the increase in consumption being about 30 per cent.

When we consider the immense efforts that have been made during the past year to produce oil; and the evident ascertainment of the limits of the producing area, together with the high probability of a continued and increasing consumption, we cannot but conclude that in the coming year permanently higher prices must prevail.

Below we give a resume of the important figures of the year's business.

The total production of crude petroleum in the Pennsylvania fields for year 1881 was 27,358,210 bbls., being a daily average of 74,954 bbls., of this amount 20,284,235 bbls., or 55,600 bbls. per day. were shipped out of the producing regions. The balance of the production, 7,073,975 bbls. or 19,381 bbls. per day, went into stock; making the total stock at the close of the year 26,019,704 bbls. The number of wells producing at the close of the year was, 18,300 with a daily average production per well of four and three-eighth bbls., against 14,700 producing at close of previous year averaging 4 9-10 bbls. per well. The total shipments out of the producing regions for the year were 20,284,285 bbls. against 15,674,492 bbls. during the preceding year.

Taking the shipments out of the producing regions as representing the wants of the trade for export and home uses, it would indicate an increase of consumption over last year of 30 per cent.

M. Coulon's New Photometer.

Its principle is that a radiometer, whose temperature is constant, turns solely under the influence of light. The apparatus consists of a radiometer bulb fixed in the middle of a cube-shaped metallic case, having four lateral apertures, closed with glass, through two of which light can be sent horizontally, while the two others allow observation of the bulb. The case is filled with water, which, by spirit lamps, is heated to a temperature above that of the radiant heat of the sources to be measured about 100 degrees. When a single source of light acts on the bulb from one side, it attracts the white half and repels the black, so that the disc turns edgewise to the light, and presents one side to the observer. If another equal light act simultaneously on the other side and at the same distance as the first, the disc presents its sides to the light and its edge to the observer. Where unequal lights are compared, by moving one of them a proper distance, equality of light is established, and the edge of the disc is turned to the observer. The difference in distance gives the ratio of intensity.

The Advantages of Generator Furnaces with Recuperation.

A paper read before the Society of Gas Lighting, January 26, 1882,
By G. Warren Dresser, C. E.

In considering the question of the best means of carbonization, the two main objects to be kept in view are economy of fuel and the securing of an abundance of controllable heat. As to the first point—economy of fuel—it is proposed to inquire, first, what amount of fuel is used in this country by the ordinary firing, and also what amount is used in England; secondly, what amount is used by the various systems of regenerator furnaces. From this the actual amount of fuel that may be saved can be determined, and, consequently, the money value of the saving, from which we shall be able to answer the question, "Do gas furnaces pay?"

There is one point met at the outset of an investigation of this kind, and that is the different amounts of coke that different managers estimate as the total product from one ton of coal; and for the purposes of this paper we will assume as that product 1,500 pounds, or about two-thirds of the weight of the coal carbonized. The method of estimating the quantity of fuel used in carbonization on the continent of Europe is different from that of England and this country. No account whatever is taken of the amount of coke made, either per ton or otherwise, when discussing the efficiency of furnaces; but the custom is to use the percentage of coke by weight of coal carbonized. For example, if it takes 20 pounds of coke to carbonize 100 pounds of coal, then 20 per cent. of fuel is said to be employed. If 16 pounds of coke carbonizes 100 pounds of coal, then the work is done with 16 per cent. It is important to understand this clearly when comparing their workings with our own, for it reduces the "percentage" used by us in the old-fashioned fires very materially. For instance, one of our managers may say he uses 35 per cent. of fuel—meaning thereby that he employes, in carbonizing, 35 per cent. of all the coke he makes, which may seem a large amount when compared with continental practice. But what is he using when expressed in the same terms as are employed on the Continent? 35 per cent. of 42 bushels = 14.7 bushels, which at 35 pounds per bushel = 514.5 pounds to carbonize 1 ton of coal, which is equal to 23.6 pounds of coke for each 100 pounds of coal; and on the Continent such a consumption of fuel would be called 23 per cent., and not 35 per cent.

In order to get ourselves on to the same basis, I have asked each of you to give me the percentage of coke made which each of you use, and I have converted these percentages into percentages of coal weights, on the assumed basis of 42 bushels of 36 pounds each; or, taking for convenience 1,500 pounds as the weight of coke produced from 2,240 pounds of coal, the table before you gives the results, and serves to answer the question, How much fuel are we now using?*

It will be seen from this table that there is considerable variation in results obtained in our practice, and that, taking the fuel by the percentage of coke made, it varies all the way from 32 to 50 per cent.; while by the percentage of weight, it varies 21.5 to 33.4 per cent. Certainly here is a margin sufficiently large for considerable improvement, even in the old way; and, what is also singular, no two furnaces are of the same dimensions. Of course it is understood that small works must use a larger percentage than large works. These works comprise almost every sized works that can be found in the country, although the larger part of them are among the largest we have; and so the average of these 18 works may be taken as a fair average of the results obtained by the old system of firing, which may be summarized as follows:

Taking the yield of coke as 1,500 pounds per ton (two-thirds of a ton = 1,493⅓ pounds), the average number of bushels obtained is 40.4, which would give the average weight per bushel as 37.1 pounds. Of this amount 41.6 per cent. is used in carbonizing, which, upon the European basis, would be 27.85 per cent. of the weight of coal carbonized.

This is, of course, disregarding the size of the works and the amount of coke made in each, but simply averaging the number of works; but it must be admitted that it shows a great waste of fuel, as one of the smallest of these reduces coke consumption from 60 per cent. to 40 per cent. of coke made by the use of a generator furnace.

When we come to look at the fuel accounts of English companies, we find the same variations in amounts produced and used as is shown here. By "Field's Analysis" for 1880 the four Metropolitan companies are reported as follows:

Gas Light and Coke Co.....	42	bush. made,	25	per cent. used.
Commercial Co.....	47	"	32	"
London Co.....	45	"	26	"
South Metropolitan Co.....	48	"	27	"
13 suburban companies, average	46	"	28	"

and of the latter companies the number of bushels made varies from 39 to 48, and the amount used varies from 11 to 48 per cent. of the coke made.

*For table see page 54.

These figures are quite remarkable. If we convert the percentage of coke made that is used by the Gas Light and Coke Company into the Continental system of expressing it, we find that the old Chartered Company is using 16.75 per cent. of fuel. Now if this is so, which we do not now believe, they are doing better than many works with the best of generators. Averaging the percentages given of the four London Metropolitan companies and the thirteen suburban companies, we have as a result that 27 per cent. of coke made is used as fuel. This, upon the Continental basis of estimate, would be 18.08 per cent.

There must be error somewhere in the amounts given as the percentage of coke made that is used for fires. I think it may be explained, however, by the fact that at many works the coke sold is very large in size, and "measures well" in consequence, thus reducing the quantity not accounted for, which of course must have been burned at the works. Of course the total amount of money received for coke by any company during a year, divided by the price per chaldron at which it was sold, will give in one form the number of chaldrons sold, and this deducted from an estimated amount made per ton of coal carbonized, would give an amount which certainly could be called "coke unaccounted for;" but it does not definitely fix the amount of fuel used to carbonize one ton of coal. This can be done by experiments conducted on a specified basis on a sufficiently large scale to give reliable results. Such experiments have been conducted by some members of this Society in the year 1879:

The coal used was 71½ per cent. Penn, 15 per cent. Blockhouse, and 12½ per cent. cannel (Peytona).

Total weight of coal per bench.....	1260	pounds.
" coke made therefrom.....	840	"

Or the coal after carbonization yielded two-thirds of its weight in coke, which was weighed hot, without any quenching. The total weight of coke used to carbonize the 1,260 pounds of coal was 338 pounds, or 40 per cent. of the coke make; or, on the Continental basis, 26.6 per cent.

It is to be hoped that some further experiments may be made, to arrive at more definite results, that conform more closely to each other.

At any rate, one thing would seem to be self-evident, and that is that when our retort-house practice follows so closely that of the English, there is no good reason why we should be so far behind them in fuel account as we appear to be, if our figures and their returns are both correct. And, moreover, why should they bother themselves about generator furnaces if they are doing better now than many of our brethren on the Continent, who have certainly brought the generator furnaces into extensive use, and who claim to have effected large savings in fuel used by their adoption?

Regretting that our comparative figures on the subject of fuel used in the old system are so unsatisfactory, we now proceed to consider the subject of

GAS FURNACES.

By this general term we would designate any of the numerous arrangements called generators, by which solid fuel is converted into a gaseous state, of which the main heating constituent is in the form of carbonic oxide; this gas being led into the base of the bench by proper channels, and there combined with the proper amount of air, which has also been conducted to the same part of the bench by proper channels and openings, so as to oxidize or burn the CO to CO_2 in the arch itself.

If the air so supplied for the combustion of CO into CO_2 has been previously heated by the waste gases passing off from the bench, we are then said to employ "recuperation," from the fact that we take back into the bench a part of the heat which was passing off to the chimney, by heating the air of combustion with it after it leaves the arch or before it reaches the chimney. So that we may have generator furnaces either with or without recuperation. It is only when the recuperation is obtained from the *exit* products of combustion of the bench that any economy obtains in this regard; for if we heat our air by heat transmitted through the walls of the generator or fireplace, we are simply robbing our fires of heat before it has done its work, and are promoting a system of internal radiation, so to speak, which cannot result in economy. On the other hand, when our air is heated by the exit gases, we save a portion of heat that would otherwise be wasted. It is upon the methods by which this recuperation is effected that most of the differences depend on the various results obtained by the different systems of furnaces in use on the Continent of Europe.

Of the many men whom I have met, and who have written upon this subject, none have impressed me as having more clear, comprehensive, and thoroughly practical views on this subject than our friend M. Demetrius Monnier, of Paris, with whom it was my good fortune to spend much time during the past summer. He, together with our fellow member, Mr. Greenough, and Mr. James Thibaudet, engineer of the Marseilles Gas Company, made a tour through England, Holland, and Germany, last summer, for the purpose of studying the subject of furnaces, and witnessing some of them in operation. It was my good fortune to be able to so arrange a trip on other business as to accompany them, and to visit

with them about twenty-five of the largest gas works in the world, in some of which generator furnaces had been at work for a number of years.

In the year 1878 M. Monnier read a paper before the Société Technique de l'Industrie du Gaz en France, entitled 'Benches Heated with Carbonic Oxide, with Recuperation by the Waste Heat." The principles underlying the whole matter are so clearly and succinctly set forth therein that I trust I may be pardoned if I give a translation of some of the main points.

Speaking of the "gasification of the combustible" he says:

"* * * The coke is disposed in a thick layer. The lower portion of the layer burns at first into CO_2 by the oxygen of the air which enters through the grate. It is in this part that the heat is greatest. The products of this combustion, in passing through the upper layers of the coke, raise the temperature thereof; the carbonic acid then combines with a new equivalent of carbon, and is transformed into carbonic oxide. The gaseous mixture resulting from the gasification of the coke is composed essentially of carbonic oxide and nitrogen, to which must be added a small percentage of hydrogen and carbureted hydrogen, resulting from the water and the volatile matters that may be left in the coke. It contains, besides, a certain proportion of carbonic acid and vapor of water which have escaped decomposition.

"It is this mixture that constitutes the gaseous combustible to be used in heating. Its calorific power depends principally upon the amount of carbonic oxide that it contains. The gasogen should consequently be so arranged that the transformation of the coke into carbonic oxide shall be as complete as possible. To this end the combustion ought to be very active at the lower part of the bed of fuel, because the elevation of temperature increases the affinity of carbonic acid for carbon, and consequently favors its transformation into carbonic oxide. On the contrary, the upper portion of the bed of fuel ought not to exceed a dull red heat. A higher temperature indicates that the decomposition of CO_2 is incomplete; for we know that its transformation into CO absorbs a considerable quantity of heat. This reaction not being instantaneous, the bed of fuel ought to be thick enough to give sufficient time for the contact between the molecules of CO_2 and the carbon, to enable them to combine. When we use coke of ordinary size, it is well to always have a bed of fuel of not less than 39 to 45 inches in thickness; and the form of the gasogen ought to be such that no air coming through the grate can reach the upper portion of the bed of fuel without passing through this thickness of fuel."

Preference is given by the author to the generators with a grate rather than those with a slit, because they are simpler to build and maintain, and may be used with any kind of coke.

In generators having a grate, "we generally give for the entrance of air below a free section of from 15 to 20 square inches for each ton of coke burned in the 24 hours. These dimensions correspond to the temperature developed just high enough to facilitate the transformation of the coke into CO, but not high enough to fuze the cinders, and is called the 'marche en cindres.'"

When cokes are not very pure this arrangement is very advantageous.

In some generators the air space is much less than this, and a very energetic combustion ensues, and the cinders are completely fused ("marche en laitiers"), giving very excellent results—there not being over two per cent. of carbonic acid in the combustion gases. But this form of generator with so small an air space is not well adapted for use when the coke yields a refractory cinder or slag, without the use of an appropriate flux.

Dr. Schilling, in his exhaustive work, "Traité d'Eclairage par le Gaz," published in Munich, and translated into French by M. Servier and published in 1879, states that the first effort at heating retorts with gaseous fuel was made in 1856, at the iron furnaces Wasseralfingen, where the experiment was made of heating benches of retorts by the waste gases from the furnaces, when it was found that 1 cubic meter = 35.3 cubic feet = in heating effect 50 to 62.5 kilos. of coal = 110 to 137.5 pounds.

In reality it is to the industry of iron furnaces that we owe the first application of gaseous fuel to gas works. In 1857 Fabre Du Faur was engaged in the study of this subject in connection with iron furnaces and utilization of their waste gases; and soon after, Bischoff, counselor of mines, made a long series of experiments with gases made in separate generators. This was taken up and followed by many scientific men in Germany, and resulted in the regenerative gas furnace of Frederick and Charles William Siemens, which, in 1862, was first tried at the Horseferry road works of the London Chartered Company, and in 1864 was introduced into the Paris works at Vaugirard, where it was carefully experimented with for some years by Dr. Siemens, under the immediate charge of M. Le Trieste, the manager of that station, and afterward, in a perfected form, was put into St. Mandè station in 1869; at Ivry in 1876–8; and at Clichy in 1880–1. At Paris the consumption of coke was 20 per cent., and later, at Ivry, 15 per cent.

The Siemens system was followed by other modifications, which aimed at doing away with the mechanical arrangements of valves, etc., which required constant care and manual labor.

Messrs. Lencauchez and Ponsard were among the earlier workers in this direction, and soon after (1870) Muller and Eichelbrenner brought out adaptations for heating retorts by gas that had quite an extensive application.

Liegel began his experiments in 1864, but, being the manager of a smaller works at Stralsund, he hesitated to put forth his ideas, feeling that one so little known would hardly be listened to. In 1870 he communicated his designs privately to Dr. Schilling, and in 1875 Mr. Schiele, the manager of the works at Frankfort-on-the-main, constructed quite a number of furnaces on this plan, and reported very favorable results. Some of these same furnaces we saw at work last summer. They are without any grate, but the draught is supplied by a "slit" in the bottom of the furnace, about 2 in. wide and 3 ft. long.

At the South Metropolitan Company, in London, Mr. Livesey has made some furnaces very similar to these in their action, in which the slit is supplied with jets of steam to prevent the overheating of the iron frame which forms the slit.

Mr. Stevenson, of Peterboro, has also made some modification of the original Liegel furnace, which show a very marked advantage over the old system of firing.

The Liegel system is patented in various countries. These furnaces have been worked here at the Metropolitan Company's works.

The experiments in France soon attracted the attention of German engineers. Mr. Oechelhauser took up the matter, and his efforts were directed especially toward the adaptation of generators to smaller existing works, and his first generator was in operation in February, 1875. As manager of the German Continental Company, which operates many smaller works, he adapted the principle of heating by gas to many of them, and with very satisfactory results; and I have much pleasure in submitting to your inspection a copy of the confidential instructions which he issued to his engineers for the management of these furnaces, which I had the honor of receiving from Mr. W. Oechelhauser himself.

Some of the adaptations he made to existing works, converting benches of sixes into eights by putting in additional retorts where the old furnaces used to be, are here shown. It will be noticed that no great regard was paid to recuperation or heating the air, as the object was to adapt the generators to existing works with as small expense as possible. Perhaps there is no one man in Germany, who, from his position as manager of a number of companies under one head, and as the President of the German Gas Light Association, has contributed more to the promotion of the system of generator furnaces than Mr. Oechelhauser. Although, from the circumstances above mentioned, he did not feel justified in going to the expense of an entire modification of his benches to secure the full benefit of recuperation, still be gained much by getting two additional retorts in a bench of sixes, and by securing a steady, uniform heat and prolonging the life of his retorts.

The Oechelhauser system is sometimes spoken of as the Dessau system, as that is the headquarters of his company. His generators are with grates.

At the same time Mr. Hegener, engineer of the works of Cologne, introduced a system of regenerators there. The works are new, and are laid out on a magnificent scale. The experiments and practical working there have been very successful.

Herr Hasse, the manager of the Dresden works, also pushed investigations in the same direction. At first his generator was built in an old house and was placed some distance from the bench; but this was afterward changed, and in his new works they are joined to the benches, in a "stage" house.

As early as 1870 Mr. Grahn, a leading German engineer having charge of the gas works at Krupp's immense iron works at Essen, turned his attention to this subject, and the generators devised by him are in operation to day. Together with Dr. Schilling and Mr. Schiele, he was on a commission appointed by the German Gas Light Association in 1876 to investigate the whole matter of heating by gas, and the different forms of furnaces, etc.

Perhaps the most important modification yet made is that of Dr. Schilling, of Munich, for he has endeavored to combine a good system of recuperation with his generator; and the Doctor told me last summer that his average working was with 16 pounds of coke to each 100 pounds of coal carbonized, or 16 per cent. In discussing with him the subject of recuperation, he summed up the whole matter by saying that the saving by recuperation amounted to from 2 to 2½ pounds of coke for each 100 pounds of coal carbonized. And it is here that the whole thing is to be found in a nutshell.

At Berlin a system of generator furnaces has been adopted in the new works and also in the old ones; while at Cologne, the Hague, and many other smaller works the advantage of firing by gaseous fuel has been admitted, and some form or other of generators have been adopted.

The fuel used in all these varies from 16 to 18 lbs. per 100 lbs. of coal.

RECUPERATION.

As to the systems of recuperation they are almost as numerous as the different kinds of furnaces that have been introduced; and, in general terms, they consist of some kind of material, usually of a refractory nature, which is heated by the spent gases of the bench on their way from the oven to the chimney, and then as the air for combustion passes through or over this material it absorbs this heat and carries it back into the oven. The practical result of this recuperation is a saving of two per cent. of fuel, calculated on the Continental basis. This seems a small amount for so large an expenditure as is sometimes made for recuperation, but it amounts to more than would be supposed without due consideration of the subject. For instance—take a setting which carbonizes ten tons of coal per 24 hours; two per cent. of 22,400 lbs. of coal (ten tons) is 448 lbs. Now, 448 lbs. of coke, at the average weight per bushel found in our table, would equal 11.17 bushels as the day's saving on ten tons of coal carbonized. At seven cents per bushel this would equal $285.39 per annum. The additional cost of construction for recuperation could not exceed $1000 for every ten tons of coal. The interest on this at 6 per cent. equals $60, and allowing ten per cent. for wear and tear, making $100 per annum more, we have as a yearly charge $160, and the yearly profit $285, showing a net gain of $125 per annum for every 10 tons of coal carbonized per day, or $1,250 for every 100 tons per day used during the year. It cannot be seriously doubted that if this amount were to be added to an engineer's salary upon the condition that the saving was made it would be deemed well worth the effort to obtain even so small an economy as two per cent. saving in the fuel account; and though foreign to the immediate subject under consideration, the remark may perhaps be pardoned that there seems to be no good reason why a manager should not receive a portion, at least, of savings of this kind which he may be able to effect in addition to the regular salary to which he is entitled.

From what has been said the advantage of recuperation becomes almost self-evident, for if there is an advantage in the use of gaseous fuel, without heating the air, this advantage becomes still greater when we properly recuperate the air, for two reasons:

1st. We return to the oven a part of the heat which was being carried up chimney, and, in reality, thereby increase the heating power of the gaseous fuel.

2d. It enables us to maintain a higher, and, at the same time, a more equable temperature.

The principal methods of recuperation may be classified under two general heads—

1st, The Siemens system of regenerative chambers filled with fire-brick.

2d. The tubular system.

Of the Siemens system the complete exemplification is in the Paris works. There is no question about the economical results obtained by these settings, but the expense of first construction has been a serious obstacle to their introduction elsewhere. The Paris company has a concession for the exclusive right of lighting Paris for 50 years, and this enables them to make constructions of a most lasting character, with the assurance that they will be allowed to reap the benefits thereof. Hence it may be good policy in their case to make large expenditures, that can be distributed over a term of years, while other companies less favorably situated might not be justified in making "permanent investments" of this character. I submit herewith drawings of the Siemens system which are doubtless understood by all of you. It consists practically of two chambers filled with fire-brick piled up in "cob house" fashion. The products of combustion pass from the generator through one of these chambers, for a time, until the material therein becomes heated to about the temperature of the escaping gases themselves. Then, by means of dampers manipulated by an attendant, the current of gases is changed into the other chamber, and, at the same time, the cold air is sent through the chamber which has been previously heated. The air is heated in its passage through the interstices of the fire-brick and meets the carbonic oxide from the generator at the base of the oven and, uniting with it, the two are burned to CO_2. This system is undoubtedly the most complete for heating the air that has been devised; but the mechanical manipulation necessary and the expense are considered by many as serious objections to the practical application of the system. This has led to modifications which seek to do away with the alternating of the currents and the mechanical appliances required therefor.

Messrs. Ponsard and Lencauchez's modification of the Siemens system was perhaps the first step towards the tubular recuperator. They dispensed with the alternating arrangements by using hollow tiles and clay tubes, passing the air through the pile inside of the tubes or hollow bricks, and the products of combustion on the outside, and thus gave very good results, which led to many other forms more and more simple.

Dr. Schilling's system of recuperation, it will be seen, is different from either the Siemens or the Ponsard; but it properly comes under the tubular class. Another system is herewith submitted, which is tubular, and was devised by Mr. Monnier,

This system of heating the air has been in use in France for a number of years, and has given excellent results, and shows no perceptible deterioration after four or five years use.

A bench constructed on this plan should produce very nearly 100,000 cubic feet of gas per day, and would practically cover 100 square feet of retort house floor—perhaps a little more.

The retorts are, as you see, nines, arranged so as to be easily worked by a mechanical stoker. They are about 15″ × 24″ × 10′, and three inches thick. The idea is to carbonize one ton of coal in each retort every 24 hours, without crowding the interior with coal. This would require the charge to be 375 pounds every four hours. That this can be done is shown from the fact that I have seen 400 pounds of coal put into a retort 15″ × 22″ × 10′ by the Ross charger, and the same burned off in six hours with the old-fashioned furnaces. If each of nine retorts can distil one ton of coal per day, there should be no trouble in making, with a bench of nines, 100,000 cubic feet per day.

Mr. M. A. Lencauchez read a paper on the subject of gaseous heating of benches before the French Gas Engineers Society last summer; and in speaking of the economy of recuperation says that, if properly conducted, about fifty per cent. of the heat usually going to the chimney may be saved. Of course in new constructions there is great economy to be obtained, first, by increasing the number of retorts in a bench and, within certain limits, the size of them, and also by care in construction to avoid a loss of heat by radiation It has been our practice to build our walls much too thin, and the consequent loss from radiation in all directions is enormous. To prevent this the walls should be thickened, and all of the interior bricks should be hollow, while the outside brick may be common brick, and the arches of fire-brick. In some instances very porous, light brick are used instead of the hollow ones, but the latter are so common now in constructions that there is no reason why the gas maker should not avail himself of them. In giving this sketch of the progress of gas furnaces I have not referred to the several forms that have been presented in our country by our own engineers because my aim has been more to show what has been done elsewhere, and how much study and thought has been devoted to the subject years ago. It is no novelty, no experiment; and there is no reason why some member of this Society should not before long erect some benches that shall contain all that is good of previous efforts by others, together with such practical adaptations as may appear likely to prove beneficial. There has been plenty of talk about the matter, and it would appear that the time had arrived for putting our information in practice.

The Dieterich system has done much good, for it has started our people to thinking. It is not perfect, and never was claimed to be. Its method of recuperation is very deficient, if it can be said to have any; but it has had the effect of demonstrating that something better than the old system exists.

The furnace of Mr. McIlhenny, of Washington, seems to embody improvements also. So far as the furnace or the system of recuperation is concerned, the principles are free; but if in practice it is found that any of the appliances used in combination with any furnace are more useful than any others, no man will be more willing to adopt them than the engineers of this Society, and to pay for them a fair remuneration to the one who has devised them.

The relative advantages of the old and new systems of firing may be stated as follows:

The first point in favor of the regenerator is that no more air is admitted than is required for proper combustion, either in the generator or the bench.

Of course, the full theoretical quantity of heat is never realized, but the generator comes nearer to it than the old furnace.

The following analyses of combustion gases* by the old furnaces and by generators, will give some idea of the excess of air which the former employ:

Old Furnaces.	1.	2.	3.	4.
Carbonic acid.....	12.6	16.0	14.0	8.0
Oxygen.....	7.6	4.0	5.5	12.0
Nitrogen.....	79.8	80.0	80.5	80.0

The first three cases were taken when the furnaces were well filled, and the fourth just before filling up.

Generators.	1.	2.	3.	4.
Carbonic acid.....	19.6	18.0	19.0	18.5
Oxygen.....	0.4	2.0	1.4	

All taken during one 24 hours.

The German experiments indicate that the generator gases enter the bench at about 1260° F., and that the temperature in the bench can not be much below 2525° F.

2d. Taking the quantity of coal carbonized and the amount of coke re-

* "Schilling," p. 315.

quired to do it, the advantage of the generator system is apparent. By the old system, from 20 to 34 per cent. *by weight* is required. By generators with recuperation this is reduced to 16 to 17 per cent. in Germany to-day in many works, both great and small.

3d. Space now taken up by furnaces can be utilized for additional retorts—sixes become eights, etc.

4th. The labor and trouble of maintaining the fires is much less.

5th. The life of the benches and retorts is increased.

Coke Used in Carbonizing.

Name of Company.	Size of Furnace. Length.		Width.		Depth		Breeze and coke made per ton.	Coke used, per cent. of coke made.	Per cent. by weight.	Remarks.
With Old Furnaces.	Ft.	In.	Ft.	In.	Ft.	In.	Bushels.			
Newport	4	0	1	2	1	6	41	40	26.7	
New Orleans	4	0	1	4	3	0	*39	†34.5	23.1	* 6% of breeze. † Average of 3 yrs.—'77 to '80.
New Haven	4	3	1	0	2	8	38	44	29.5	
Pawtucket	4	0	1	2	.....	.....	38	*40	26.7	* December.
Providence	4	6	1	0	.....	.....	42	*41	27.5	* Average of five months from July to December.
Boston	4	2	1	2	1	8	42	38	25.5	
Lawrence	4	0	1	2	2	0	43.4	*40	26.7	* Includes boilers.
Laclede	4	3	1	4	2	6	42	48	32.5	
Jersey City	4	6	4	6	1	6	*42.8	32.1	21.5	* 6 per cent. breeze.
Newark	4	0	1	0	1	10½	41	*46.4	31	* Burns tar. Coke used with tar, 32.7 per cent. of coke made. 6.7% under boilers.
Brooklyn	5	1	1	3	1	8	40.31	36.24	24.27	
Manhattan (N. Y.)	4	0	1 1 1	1 3 5	3	6	40	40	26.7	
Charleston	4	3	11, 18, 14		2	5	42	*50	33.4	* Tide water under ashpans.
Cincinnati	4	4	1	2	1	10½	*42	50	33.4	* 2 bushels breeze.
Troy	4	6	1	5	1	8	41	*36	24.1	* Uses tar and 23 per cent. of coke made.
Bergen Point	4 4	0 6	1 1	2 5	1 1	8 8	*40	50	33.4	* 90 per cent. Penn, 10 per cent. Cannel.
Nassau	3	3	1	2	1	6	36.5	43.8	29.3	
Williamsburgh	.....		.....		.....		37	40	26.7	
Generator Furnaces.										
Derby	Dieterich Furnace.				.....	.....	.....	40	26.8	
Providence	Dieterich Furnace.				.....	.....	.....	.....	16.81	
New Orleans	Generator.				....	.....	.....	24.1	16	* Retorts, 8 ft. 8 in. × 14 in. × 25 in.
Cannes, France	Liegel, with Recuperation				.....		.....	.....	12	* As stated by G. E. Stevenson, *Jour. Gas Lighting.*

The Domestic Softening of Water from the Chalk.

At the recent Health Congress at Brighton, the Mayor (Alderman Hallett) read a paper on the above subject, in the course of which he said the benefit to arise from softening chalk water for drinking purposes was often discussed, but unless a water company undertook the task, consumers continued to drink the hard water as though no remedy was within their power. His object was to state a means by which softened water could be obtained with little trouble and at small expense.

It was more than a quarter of a century since Dr. Clark, of Aberdeen, made known his valuable invention, and, as the patent had expired, the application of the system was open to all who were disposed to make use of it. His description was substantially as follows:

The invention was a chemical one for expelling chalk by chalk. Chalk consisted—for every pound (16 oz.)—of lime, 9 oz.; of carbonic acid, seven ozs. Nine ounces of lime, which could be obtained by burning in a kiln, required at least 40 gallons of water to dissolve it. This was called lime water. Chalk was very sparingly soluble in water, so that one pound would require 5000 gallons to dissolve it; but if there was combined with it an additional seven ounces of carbonic acid, the chalk became readily soluble in water, and when so dissolved it was called bicarbonate of lime. If the quantity of water containing the one pound of chalk with seven ounces additional of carbonic acid were 400 gallons, then the solution would be a water of the same hardness as well-water from the chalk strata, and not sensibly different in other respects.

Thus it appeared that one pound of chalk, scarcely soluble at all in water, might be rendered soluble in it by either of two distinct chemical changes—soluble by being deprived entirely of its carbonic acid, when it was capable of changing water into lime water, and soluble by combining with a second dose of carbonic acid, making up bicarbonate of lime.

Now, if a solution of the nine ounces of burned lime, forming lime water, and another solution of the one pound of chalk and seven ounces of carbonic acid, forming bicarbonate of lime, were mixed together, they would so act upon each other as to restore the two pounds of chalk, which would, after the mixture subsided, leave a bright water above. The water would be free from bicarbonate of lime; free from burned lime; and free from chalk, except a very little. A small residuum of the chalk remained, not separated by the process.

Of the 17½ grains in a gallon of water only 16 grains would be deposited and 1½ grains would remain. To soften water on a small scale, it was necessary to provide lime water about 1-10th of the quantity of water to be treated. He had used during the last elve months two gallon stoneware casks with wooden casks with wooden taps. The casks were placed near a constant service tap; 1½ pints of lime water being first put in, the cask should be filled up to two gallons. After standing 24 hours, the supernatant water would be as clear as before, and at the bottom of the vessel would be found a precipitate of chalk.

The shape of the vessel would be better if cylindrical, with a tap hole a short distance up the side. This form of vessel would allow the process to be completed in twelve hours. The second cask or vessel was to form a reserve of the clear water which was being treated. He had been thus supplied without any difficulty.

There was no weighing of the lime required. If it was objected that the quantity was small, he answered more casks could be used, or larger ones, so as to meet the requirements. This softening might easily be applied by laundresses by using larger casks, and the saving of soap would repay them for the little trouble.

Three years ago, when the Warren Farm Industrial School well was under discussion, it was said that soft water was a saving of many pounds per annum, compared with what would be the cost of using the town water. The town water was used now, and the time seemed to be come for the Guardians to consider the use of a softening apparatus fitted for extensive use—Porter-Clark's or the Atkins process.

The Sixth Report of the Rivers Commission (1874), page 205, put the saving in soap by the use of lime as follows:

One cwt. of lime will do the work of 20¼ cwt. of soap; cost of one cwt. quicklime, 8d.; cost of 20¼ cwt. of soap, £47 1s. 8d. There was, therefore, very little question that the adoption of some mechanical means of mixing and rapidly filtering off the separated chalk would soon be paid for by the saving of soap.—*Journal of Gas Lighting.*

Illuminated Clocks.—Although New York has a number of illuminated clocks, scarcely any of them have dial plates easily read at night, except by persons of decidedly strong sight. One of the best night clocks in existence is that at the Horse Guards Building in London. The light, known as the Bude light, is not within the clock, but is thrown upon it, just as that of a bull's-eye lantern is thrown on a dark corner. This light was invented by a Cornish *savant*, Sir Goldsmith Gurney, who called it Bude after his native place.—*Iron Age.*

Smoke Nuisance.—Six engine houses built in the heart of San Francisco to operate cable roads aggravated the "smoke nuisance" to such an extent that a case was brought in the court for its suppression. Within the last few days Judge Evans, of the Superior Court, awarded damages to the plaintiff, who owns a dwelling adjacent to the engine house of the California Street Railroad Company.—*Iron Age.*

[From the "Journal of the Society of Arts."]

The Storage of Electricity.

By Sylvanus P. Thompson, B.A., D.Sc., Professor of Experimental Physics in University College, Bristol.

[Continued from page 34.]

APPLICATION OF PLANTE'S ACCUMULATORS TO ELECTRIC LIGHTING BY INCANDESCENCE.

Faure's cells have already done good work in providing an efficient means of working incandescent lamps, such as those of Swan and Maxim, for domestic purposes I have the pleasure of showing you to-night the result of passing through two chandeliers of Edison's little incandescent lamps the current generated by forty of Faure's accumulators. Here are also some of the incandescent lamps of Swan and of Maxim, lit up by the same means. I have to thank the representatives of the various companies for the courtesy that has put at my disposal these means of illustrating my discourse.

Careful and precise measurements have been made by Sir William Thom son and Mr. J. T. Bottomley, using from 20 to 70 Faure cells as a source of current to illuminate some of Swans lamps. These measurements have shown that the efficiency is very considerable, and that where from 35 to 50 such cells are available, the light produced by one lamp may range from 300 to 400 candles per horse power, the latter being measured as actually consumed in the lamp.

Swan Lamp, No. 1.

Number of experiments.	Cells.	Volts.	Webers.	Volts × webers ÷ 10 = kilogrammeters.	Horse power.	Candles.	Candles per horse power.
1	26	56.9	1.21	6.88	.093	11.6	125
2	30	65.5	1.46	9.56	.129	25	194
3	32	70.2	1.64	11.51	.156	42	263
4	33	71.8	1.74	12.48	.170	38	224
5	34	74.1	1.81	13.42	.181	44	243
6	35	76.1	1.82	13.86	.187	55	294
7	36	78.0	1.99	15.52	.210	63	300
8	37	80.3	2.06	16.54	.224	66	295
9	38	81.9	2.06	16.88	.228	76	333
10	39	84.6	2.06	17.43	.235	82	349
11	40	87.0	2.10	18.27	.247	84	340
12	42	90.9	2.17	19.72	.267	102	382
13	44	92.0	2.11	19.96	.270	89	330
14	46	99.1	2.27	21.91	.296	114	385

Carbon of lamp broke with same power, immediately after the measurement of the light was completed.

The foregoing statistics of one series of experiments are taken from the paper read by Sir William Thomson at the meeting of the British Association at York, September, 1881. From these experiments it appears that a high degree of economy in lighting by incandescent lamps is really attained. Should the accumulator be further improved, to reduce the percentage of waste between charging and discharging, accumulators will play a very important part in future installations, provided they can be constructed at a prime cost, lower than the present figures.

At the Paris Exhibition of Electricity, Faure's batteries have been doing excellent work. The following details of the separate installations will give an idea as to how many cells are required for a given number of Swan's lamps:

	Swan Lights.	Faure Cells.
Vestibule	23	56
Kitchen	4	
Bathroom	2	
Telephone room (No, 7)	17	29
Telephone room (No. 8)	18	29
Exhibit of the Compagnie La Force et La Lumières	34	56

FURTHER APPLICATIONS OF ACCUMULATORS.

In an article on electrical storage, which appeared in *Nature* on June 2, 1881, I pointed out the usefulness of accumulators, in the following words:

"The uses for such secondary batteries may be of three kinds:—1. They may serve as portable supplies of electricity to be left and called for to recharge when exhausted. 2. They may serve to accumulate supplies of electricty from dynamo-electric machines, and store them until required for furnishing electric light or motive power on a small scale. 3. They may serve as equalizers of electric currents in a system in which the supply is liable to fluctuations. Suppose, for example, a dynamo-electric machine is employed to produce electric light. Any least thing which alters the speed of the machine, even for an instant, makes the light flicker and change in intensity; while the breakage of the engine-strap would at once cause total darkness. But if a secondary battery of suitable dimensions and power were inserted across the circuit between the dynamo machine and the lamp, the inequalities of the current would be greatly modified When the light was not in use the battery would store up the current. If the engine failed the battery would at once put forth its power. It is probably in this direction that the secondary battery will find no unimportant field of usefulness."

Of the first and second of these purposes you have an illustration to night, this medical Planté cell and these forty Faure cells having been brought to this room charged, for the purpose of showing you their powers. The third possible use has been also emphasized by Sir William Thomson, who, at the September meeting of the British Association, gave details of a scheme of automatic adjustments to make and break the circuit between the dynamo machine and the secondary battery, so as to guard the former from damage and the latter from waste.

As to portability, for such purposes as domestic lighting, the cost and risk of carting the heavy cells to and fro is probably prohibitory. For special purposes, such as those of galvano-cautery already mentioned, the Planté accumulator is certainly superior to the Faure, since it is lighter, and at the same time gives up its charge more rapidly, though its storage power for cells of equal bulk is less than that of the Faure.

MAXIMUM TEMPERATURE ATTAINABLE BY A CELL.

In connection with the subject of obtaining a high temperature by means of a cell, it may not be out of place to point out that the very high electromotive force of these accumulators (about 2.2 volts), exceeding that of any single cell of any other kind, carries with it the possibility of obtaining with such a cell a lower electromotive force. This discovery is due to Lorenz, of Copenhagen, who, in a remarkable paper published (in "Wiedemann's Annalen") in August last, upon the relation between the conducting power of metals for heat and for electricity, has shown that the highest possible temperature to which a cell can raise any part of its circuit is proportional to its electromotive force. The highest point to which a Daniell's cell, however large, can raise a conductor is, according to Lorenz, 3,327° above the zero of the Centigrade scale. The limited temperature for a Planté or a Faure cell is 6,927°.

APPLICATION TO BLASTING AND TORPEDO FIRING.

The great calorific power of these accumulators, due as much to their small internal resistance as to their high electromotive force, is doubtless of great importance in the application to the firing of torpedoes and blasts in mining. The special batteries now used might economically be replaced by one or two storage cells provided with a charging battery of half a dozen Daniell's cells, whose slowly produced currents could be thus accumulated.

APPLICATION TO PERFECTION OF THE TELEPHONE.

Another application of the secondary battery which has occurred to me, and which, on a small scale, I have tried with success, is in connection with telephone transmitters. There is still room for improvement in the telephone; at the best, the speech it transmits is neither so loud, nor so distinct, nor so free from extraneous sounds, as might be desired. The fault lies almost wholly with the transmitters. They will not transmit loud sounds distinctly. The strength of the currents generated by the Bell telephone, used as a transmitter, is limited by conditions which are wholly distinct from those which limit the possible strength of the currents transmitted by a "microphone" or "carbon transmitter." My remarks must be understood as applying to the latter kind of instrument. If you put a very strong current on to a microphone, so as to make it, as you think, speak more loudly, the end is not attained. The points of contact get hot; there is a whirring and wheezing heard at the receiving end, and the speech degenerates into confusion. There is, then, a practical limit to which the strength of current flowing through a microphonic current can be carried. Some of the transmitters in use employ three or four points of contact, the current being carried through these either in series or in branching arcs. In the first of these two cases the limitation is only pushed back by one stage. In the latter case, one only of the contacts usually does the real work of transmitting—namely, that whose resistance is least. I propose to increase the power of a transmitter by employing a multiple microphone, so arranged that a fairly strong current shall pass through each point of contact, and that the current through each contact shall be independent of that through the rest. I therefore arrange all the individual microphones in parallel arc, in the line circuit, but provide each with its own battery. A hundred microphones thus united, and simultaneously acted upon by the voice, will each add its own quantum to the total effect in the circuit, and the result will be loud and distinct speech. But a hun-

dred microphones so arranged, each with its own battery, implies two or three hundred cells. Here the secondary cell comes in with great advantage. I propose to use very small storage cells, each consisting of two small leaden plates, or wires, dipping into dilute sulphuric acid, and properly "formed." Two such cells may be connected with each microphone, and the whole, being already arranged in parallel arc in the circuit, can be kept charged by merely placing across the circuit six Daniell's cells, to be switched off when the transmitter is to be used, and switched on again when the transmitter is no longer required. As yet only a small and rough model of this "secondary circuit transmitter" has been made; but it is extremely satisfactory in its action, and promises to be the first of a useful and important application.

APPLICATION TO RAILWAY PURPOSES.

A proposition is now about to receive practical application to light a railway train with Swan's lamps, by means of Faure's accumulators. This is the new Pullman car train, plying four times per diem between London and Brighton, which will be lit by forty Faure cells. The trial trip is to be arranged in a few days. A train might be contrived to store electricity gradually, by a dynamo electric machine fixed to the axles of the carriages, and thus to have a supply of electricity to be turned on when the train passes through a dark tunnel.

APLICATION TO UTILIZATION OF WIND AND WATER POWER.

And, lastly, though by far the most important of all the innumerable possibilities opened out by the storage battery, is its application to the problem of utilizing and transmitting the energy derived from wind or water power.

The difficulty of utilizing water power is that it is so often not to be found where it is desired; the difficulty with wind power is that it fails too often just when it is wanted. The reversibility of the dynamo-electric machine solves the difficulty of the where, by giving us a means of electric transmission. The reversibility of the voltaic cell will probably solve the difficulty of the when, by giving us the means of storing energy when we can get it, until such time as required for use. The accumulator will probably play an important part also in the distribution as well as in the storage of power transmitted from a distance, and thus become the ally of the dynamo-electric machine. It is certain that we cannot, with our diminishing coal fields, long afford to neglect these other sources of natural power.

In his Presidential address to the Mathimatical and Physical Section of the British Association, Sir William Thomson has dealt with this question, and has come to the conclusion that, though tidal power be practically unlimited, it will not pay economically to build tide basins to utilize this power, as the reclaimed land would be of greater productive value; and that therefore we must not look to the tides.

If I may venture modestly to differ from so great an authority, I would point out that there are cases where no great expense would be incurred in utilizing natural tidal areas as basins, where the area so utilized could not possibly be reclaimed or worked as profitable land, and where the rise and fall of the tide is greatly above the figure which he assumed. The river Avon at Bristol furnishes a case in point. It requires but a few yards of embankment to be turned into an available tidal area. The average rise and fall of the tide at the city of Bristol, five miles from its mouth, is 23 feet. According to calculations I have made from the average volume of water displaced up and down each tide, there are no fewer than 20 billions of foot-pounds of energy wasted every year, or enough to charge 10 million Faure cells. At the mouth of the river the total annual tidal energy thus running to utter waste cannot be less than 50 billion foot-pounds. In the rapid currents of the river Severn, with its enormous tides of great volume, the tidal energy must be practically unlimited. A tenth part of the tidal energy in the gorge of the Avon would light the city of Bristol. A tenth part of the tidal energy in the channel of the Severn would light every city, and another tenth would turn every loom and spindle and axle in Great Britain. But the power would have to be not only transformed and transmitted, but stored, to be available for such ends.

Accumulators are therefore a necessary feature in any scheme to utilize the intermittent forces of the tides. Whether the present form will prove adequate to the purpose, the future must decide. Probably the present accumulator bears as much resemblance to the future accumulator as a glass bell jar, used in chemical experiments for holding gas, does to the gasometer of a city gas works, or as James Watt's first model steam engine does to the engines of an Atlantic steamer. When the practical accumulator of the future has been built, it will be more easy to say what will be the limit of its applications. There are, as I have sufficiently shown, immense possibilities in store. Electrical railways and electrical tramways are now existing facts. Many months will not elapse—or it will be an eternal disgrace to the first city in the world—before the fœtid and poisonous atmosphere of the Metropolitan Railway is replaced by a pleasant and salubrious air, rich in fragrant ozone; and the like revolution will not be long delayed in many quarters where reform is far less imperative. In all these changes the accumulator will have its part to play. A reserve of electrical energy stored till wanted will be a necessary part of all systems of electric distribution, whether for the purpose of lighting or for motive power.

In conclusion, I would point out how the invention of the accumulator for storing the energy of electric currents has arisen out of the study of an obscure and unpromising detail in the science of electricity—the phenomenon of so-called "polarization." Regarded by most experimenters merely as a trivial but disturbing fact in the construction of voltaic batteries, to be put down or got rid of by whatever means, it has been developed, and, mainly by the long and patient researches of one man, M. Planté, and finally by the brilliant idea struck out by M. Faure, been turned into one of the most fertile and promising features in the development of the science. It is the old story over again of the reward which follows patient investigation of unexplored corners and waste places of science. Grand principles and sweeping generalizations are magnificent weapons to the scientific investigator. The principle of the conservation of energy has reaped triumph after triumph; and a kindred generalization in the science of electricity is destined, as I think, to lead to scarcely less important results. But there are other ways of adding to the sum of human knowledge besides the following out of grand sweeping principles. There are half-forgotten observations, unconnected, unexplained, and often exceptional in character, every one of which has a significance of its own—residual phenomena, every one of which is, to the scientific man, of a value beyond price. He who investigates them patiently may find the clue to their meaning and reap a rich reward from them. They are the finger posts in the high road of scientific discovery.

Discussion.

The Chairman, in proposing a vote of thanks to Professor Thompson, said that gentleman had gone a long way back for the origin of secondary batteries, viz., nearly to the time of the invention of the voltaic battery itself; there was, however, a very interesting little book which had been shown at the Paris Electrical Exhibition—a note-book of Galvani's—in which it was recorded that in 1795, five years before the discovery of the voltaic pile, he had made an experiment, and discovered a secondary battery, and also made use of a galvanometer, which was not quite the same as that which Professor Thompson stated was used by Ritter. The primary battery which he employed was the electric eel, by means of which he gave a charge to the legs of a frog, and then using the frog as a secondary battery, and himself as a galvanometer, he was able to get a secondary electric discharge. With regard to the vexed question of electromotive force, he was glad to see that there were figures put forward, though there had not been time to go into them, which confirmed the results arrived at by himself with regard to the amount of electromotive force of the Planté cell. The results arrived at by Sir William Thomson show that the electromotive force of the Planté cell lies between 2 and 2½ volts. The development of this subject had been very rapid indeed. Only a little more than four months ago the Faure battery was quite unknown in England; it was in fact shown for the first time in July, when he had the opportunity of showing it at King's College, through the kindness of M. Faure, and demonstrating how the electric light might be obtained by its means; but since then its development has been very rapid. With regard to the amount of work capable of being stored up, they had heard of millions and billions of units, which he feared would not convey a very definite idea to the general public; but perhaps the Electrical Congress of Paris had done a little in suggesting names for electrical units, and if instead of hearing of such enormous numbers of foot-pounds in connection with electricity, they could get the work represented by so many "volt coulombs," putting together the units of electromotive force and quantity, it would be simpler, and a better idea would be conveyed of what the unit really was.

Prof. Abel, F.R.S., said he had been greatly interested and instructed by this very lucid paper; a more complete account of the very rapid development of this subject could not have been given in so short a space of time. He did not pretend to be a scientific electrician, though he dealt sometimes with the practical applications of electricity; and he had listened, therefore, with the greatest interest to what Professor Thompson had told them of the recent developments which the secondary battery had received and was still receiving. As he listened to him he began to feel sanguine that these applications might be realized. There were some directions in which, if they could obtain a moderately portable battery, which could be recharged in a reasonable time, he could see applications that would be of the highest importance. He alluded to the illumination of coal mines, a matter in which he was particularly interested; and he did begin to hope that they would before long realize the expectations of some sanguine philosophers, and that electricity would be used for this purpose. Up to quite recently he had been very doubtful, for, having seen some of the first attempts, he had had reason to fear that the necessity for conducting wires along the work-

ings, and in places liable to great falls of the roof and accidents, might lead to injuries not merely fatal to the also, possibly, to the lives of the miners, in consequence of sparks which might ignite the inflammable gases. If, however, they could see their way to transport to the furthermost parts of the mine a convenient form of secondary battery, with which they could work readily with only short lengths of wire, and if small portable lamps could be attached to the men's caps, there would be accomplished what might be considered the most perfect and safe illumination of a mine possible. This he hoped would be done before many years. There were, no doubt, many other directions in which the stored up energy might be very advantageously used.

Prof. Frankland, F.R.S., said this invention of the storage of electricity was most important in connection with the applications of this force which were being made at the present time. It was a reproach, not altogether unfounded, against the dynamo current as ordinarily produced, that it might at any moment fail from the accidents of machinery or other causes; but such failures would be entirely obviated by the aid of a suitable and effective storage battery, of the kind invented by Planté and Faure. He should like to ask Professor Thompson whether, in his numerous experiments on this subject, he had gone at all into the subject of the length of time this force could be kept stored up in the battery. This was an important point, which he feared, had been a good deal neglected hitherto. He should like to know whether there was any considerable amount of leakage, and if so, how much, and for what length of time a battery might be expected to retain its charge. He could only conclude by expressing his best thanks for the very able lecture Professor Thompson had given.

Mr. Evans asked if a number of Faure accumulators could be used to store up the power derived from water-wheels, so that the wheels or turbines might work during the night, and the power thus stored be used during the day.

Mr. Shoolbred wished to add a word or two in regard to De Méritens' battery. He had lately returned from a visit to Paris, and he found the form in which De Méritens was now making his battery in a practical way differed considerably from the form in which it first appeared, and which had been shown on the screen. Each cell consisted of a solid lead, filled in with thin sheets of lead, less than a millimeter in thickness. It was much simpler than either the Faure or the original Planté battery; whether it was as efficient, yet remained to be seen; but the one in the exhibition worked very well. De Méritens had informed him that it took from fifteen to twenty days to form a cell, not, as he had understood Dr. Thompson to say, six months. He had hoped to have got one to bring over, but could not do so. With regard to the figures in the table (see p. 8), and which he saw were Sir William Thomson's, he wished to say that, by the kindness of Sir William Thomson, he was enabled to repeat the experiments for photometric measurements, with the aid of Mr. Keats, of the Metropolitan Board of Works, who kindly brought over his own photometer, and the candle power came out even higher than as given by Sir William Thomson.

The Secretary said he was happy to announce that he had seen M. De Meritens very recently in Paris, and he promised that he would send over a complete set of his batteries to the Society of Arts as soon as they were ready in January or February next.

Two further questions having been asked, viz., as to the expense of producing the light, and why the electric energy in the secondary battery was not given off at once.

The Chairman put the vote of thanks to the meeting, when it was carried unanimously.

Prof. Thompson having acknowledged the compliment, said he would answer the last question first, and he might do so by asking another. How was it that a voltaic battery gave off its energy gradually, instead of going off with a bang? You could not get zinc to dissolve at more than a certain rate; nor in the case of the stored battery could you get the peroxide to reduce itself, and the reduced lead to oxidize itself, at more than a certain rate. Besides, if by any possibility the battery did go on at too great a rate, it would polarize itself—it would begin to reduce the side toward which the current was going, and so bring down the amount of current passing. The rate at which the action went on depended on the conducting power of the lead, its resistance to electricity, and the amount of surface exposed; also on the condition of the deposited substances. A piece of coal did not give up its energy all at once, when put into the fire. As a matter of fact, the action at the surface did not go on at more than a certain rate. As to the expense, he should not like to give figures which he could not stand by in a court of justice, and therefore he would not give any. At the same time he should like to explain that he believed the expense of the light then shown would be less, considerably, than it would cost to produce the same amount of light by making gas. For a steam engine with the necessary plant to work a small dynamo machine, and the necessary accumulators to store it up sufficiently to give out for four or five hours a light like they saw before them, would certainly not cost as much as to have to set up a gas generating apparatus with a small gasometer, and the pipes, to produce gas of an equivalent value. When the prime cost was less to begin with, he had simply to consider the cost of maintenance; and he was quite certain that the gas put into a gas engine to work a dynamo machine would produce more light electrically than it would if burned directly. There was now no question on that score. With regard to the water wheels, if they were used to work a dynamo machine for fourteen hours, and during those fourteen hours the electricity were stored up in an accumulator, or set of accumulators, it would be a much cheaper and better way of obtaining and storing electricity for lighting, or any other useful purpose, than setting up a large dynamo machine to produce the light directly. For instance, in the Savoy Theater they had a large number of lights produced directly from dynamo machines driven by steam engines, and the lights, when they were all on, flickered up and down on account of inequalities in the driving. If they employed 1-5th or 1-6th of the driving power, and worked the engines all day into accumulators in the cellars, he believed they could not only work the lights far more steadily, but far more economically. He had been asked by Professor Frankland what waste there was by lapse of time in these accumulators, and he had made some inquiries that morning as to what happened on a practical scale, and he was told by Major Seaver that he reckoned there was about ten per cent. per week loss from batteries left idle. As a fact, they really did not yet know the conditions under which the leakage took place, whether by surface conductivity, by electrical convection, or what. There was a certain amount of waste, but, nevertheless, there were cases in which a very considerable amount of the charge had remained for a considerable time. For instance, there was the celebrated box which was sent from Paris to Sir William Thomson, containing four small cells rolled up in spirals, and packed together. When they went to Glasgow, they contained the million foot pounds; they had been partly discharged again and again, and yet they would work a small lamp, and would give light for many hours, probably. Then some of the Planté cells would retain their charge for a long time. The medical cell he had shown them was brought from Dublin by Professor Barrett a short time ago. He had used it in Dublin. It was then sent to him at Bristol, where it was used, and then it came there, and there was a considerable amount of force in it yet, though, unfortunately, in an evil moment they broke the glass, and half the liquid ran out. The Planté cell held its charge a long time, and he did not see why the Faure should not be equally successful. With regard to the De Méritens battery he did not mean to be taken literally when he said it took some six months to get the cells into a working state, but he did think it was a step backwards to use Planté's method of long continued electrical action, instead of Faure's more rapid process of producing the peroxide from red lead. He must conclude by expressing his thanks to those who had so kindly assisted him by lending apparatus for the purpose of the lecture.

During part of the evening the room was lighted by a number of Edison lamps, worked by Faure batteries lent by the Société de Force et de Lumière. Incandescent lamps by Swan and Maxim were also shown at work.

Gas Still Ahead.

Neither in Europe nor in America has the electric light been brought into use for domestic purposes. Mr. Edison long ago announced that he was ready to do it, but we still wait for him to introduce his lamps in place of the gas light, on which we continue to rely; and no one can find out how much it costs him to produce the light of which he merely gives exhibitions.

These lamps shed their brilliant illumination in the Fifth avenue headquarters of his company, where they were placed a year ago; but he is not ready to supply the others he was to have lighted in a large district of the city months since. The impossibility of getting the necessary machinery and piping, the officers tell us, has compelled them to suspend the work.

For street illumination the carbon points are successfully used here and elsewhere. The shopkeepers in the Bowery and Sixth avenue especially are very partial to them. They put the lamps outside of their doors and in their shop windows as a means of attracting attention; and the rivalry of trade has made their use very general. But no one can call the light very agreeable. It may do for the street, for large spaces, but it is not adapted to private purposes—at least that furnished by the system used by the city and by the trades.

Meantime, owing to the long delay of Mr. Edison, regarding whose ultimate success there is growing skepticism, gas stocks are rising, the advance in the last year having been very large. The chief New York companies continue to declare large dividends, and those in London never made so much money as last year. The consumption of gas is steadily increasing, both because of the growth of population and because of new uses to which

it is put. The electric light may compete with it as a means of street illumination, but only a small fraction of the quantity manufactured is consumed by the municipalities, and the electric competition there is not of much account. So long as the gas companies have the supplying of dwellings and shops, they can afford to be more or less indifferent as to public highways. They might lose all of them and yet do a very profitable business. When the electric light draws off from them their private customers, then their day of suffering will have come. But it will not come until then.

Mr. Edisons failure to take advantage of the present open winter, during which building operations, for instance, are proceeding as steadily and briskly as in springtime, is giving these companies renewed courage, and leading them to speak of his project with even greater contempt than in the past. Moreover, the cost of the manufacture of gas has been much reduced within the last few years. The threatened competition has also lead to the improvement of the quality, until now a comparison between the light as furnished by new burners and the electric light is boldly invited in London. The *Engineer* of that city looks forward hopefully to the time when 16-candle gas will be sold in London for fifty cents the thousand feet, and when for all purposes of illumination it will be made so far superior to what it now is that the gas companies can regard the electric light with "unimpaired equanimity."

Yet it is plain enough that the public have by no means lost their confidence in the ultimate if not near success of the electric light for all purposes of illumination. They still regard it as a powerful rival of gas in the not distant future. Gas stocks still command comparatively low prices in New York. Though they have advanced greatly since their depression after the premature announcement that the problem of furnishing the electric light to dwellings had been solved, they are even now sold at small figures, considering the dividends paid on them.—N. Y. *Sun*, Jan. 16.

The Public Lighting of Chesterfield, England.

The town of Chesterfield was plunged in darkness on the 31st of August last, owing to a dispute between the Corporation and the gas company. Since then the inhabitants have been subjected to all the losses and annoyances which are inseparable from defective street lighting; but for a long time they have borne these evils with patience, because they were annoyed at the line taken by the gas company, and were disposed to do anything rather than yeild to what they considered was arbitrary treatment. It was pointed out by us and others at the time that the quarrel was an absurd one, and might be readily settled; but temper ruled the day, and both sides have suffered in consequence. Worse than this, the public were mislead by a local contemporary into believing that they could get adequate public lighting by electricity at one-third the cost of gas, and as a consequence they have had no system of lighting at all; but we very much doubt if there has been a penny of saving, and we fear a heavy loss.

The present state of public lighting in Chesterfield may fairly be described thus:

There are a few large elebtric lights in the main thoroughfares at long distances apart. These lights burn in a most disappointing manner. They never give the same light for two minutes together, but after burning brightly for a few instants, they fluctuate, flicker, and subside into a yellow half-light, which change is accompanied by sounds of some curious conflict within the globe, among the carbons, plainly audible for a distance away. After some further time and sundry buzzings and other noises, sparks are seen, and the light becomes brighter again; but it never remains constant for even one minute, and at no time does it give an even radiance.

As to the power of these lights, which is described as 2,000 candles, the probability is that they do not average 200 candles, and most certainly they are immensely overrated in illuminating power at their very best. But even when at their maximum, the distances they are supposed to light in Chesterfield are far beyond what they can do. But if the wayfarer in Chesterfield leaves the main streets his fate is even worse. Not one of the incandescent electric lamps has been provided, and the town is therefore either in total darkness as to these streets, or it has to trust to the services of lamps much inferior to gas. The best of these are called "gas oil" lamps, and a few of them are to be found here and there; but they are lighted with no regularity at all, and the chances are that the side street the passenger wishes to visit will be in darkness just when light is required. There was a previous attempt to light these side streets with "Kelly" or "English" lamps—an oil lamp with a chimney, but protected by an outer glass like an ordinary gas lamp. The doleful and dismal failure of these lamps has excited universal ridicule.

We have given above a plain unvarnished narrative of facts, which any reader can verify; and we do so from a sense of duty, as Chesterfield has been vaunted all over England as a town which has solved the problem of electric lighting. It is high time the farce came to an end and the inhabitants went back to gas, which will at any rate supply their wants with precision and regularity, and at a far more economical rate than this unmatured electric light. We have warned the ratepayers from the first against the folly of this experiment, and day by day they are becoming more and more convinced that we were right. The problem of street lighting by electricity is not yet solved, and, judged by the experience of Chesterfield, it will not soon be solved; for if at the end of four months a small town like this cannot be properly lighted by amply paid contractors, what can we say of the system?—Derbyshire *Times*.

The Economical Use of Gas for Domestic Purposes.

The second of the lectures delivered at the Smoke and Fog Prevention Exhibition at South Kensington last month was by Mr. Thomas Fletcher, F.C.S., of Warrington, the main object of his lecture being, as he said, "to show how, at a very small first cost, the coal consumption in private houses can be reduced to about one half what it generally is at present."

After pointing out several modifications that might be made in domestic heating apparatus, Mr. Fletcher asserted (what is now generally admitted) that for irregular domestic work gas, as a fuel for cooking, is less than half the expense of coal, simply because it can easily be used to do exactly what is needed without waste. Some cooking stoves are, he said, made which, if needed throughout the day, are both economical and good; but, as used for irregular domestic work, they, at their best, do not bear the faintest comparison with gas. Our kitchen fires need to be blocked up with firebrick, and used simply for warming during the severest weather, and as a stand by in case of failure of gas supply. They are fit for nothing except as a poor reserve in case of accident or extraordinary pressure of work, and for this they may be left as they stand.

Later on he spoke as follows—

As I said before, gas is, for all small and irregular work, almost faultless, and very cheap. For heavy and continuous work it is excessively costly as compared with coal; and, where coal is any consideration, its continuous use for heating purposes is to be condemned. Those of you who have, or have had gas fires, will no doubt be able to bear me out on this point. A really good bright gas fire of the usual form will cost in continuous use as much as at least ten coal fires of equal power in a properly constructed grate.

I have invented a new form of gas fire, in which the radiant heat from the open illuminating flame is used, and the remainder of the heat, which is not utilized in this way, is absorbed by a number of upright tubes open at both ends. This I think is, so far as actual work is concerned, a decided step in advance. The rapidity with which a large air space is equally and comfortably warmed by a small arrangement of this kind is something wonderful. In addition to the radiant heat, which warms the lower part of the room, there is also a strong breeze of warm air thrown from the apparatus, and which can, if required, be taken from outside the building, causing a rapid circulation and warming of the whole of the air.

It has been recently proposed to use gas as an assistance to coke fires. From my own experience I can safely say that, provided the fire grate is lined with clay at the bottom, sides and back, the addition of gas to a coke fire doubles or trebles the cost without the slightest advantage in brightness or cleanliness. The gas certainly lights the fire without the use of paper or wood, but the long time required to get a bright fire is practically a nuisance, and the advantage of speed in lighting with wood more than compensates for the trouble.

Owing to the difficulty of entirely removing the sulphur from ordinary gas, there is always more or less taint when this is burnt in large quantities in a close room without ventilation. We must also bear in mind that about 25 cubic feet of gas costing in London about 0.1d.—*i.e.*, our fuel, duty for duty, costs ten times as much, provided both can be burned with equal economy, as undoubtedly they can for continuous work, with a proper system. The expenditure on a gas cooking apparatus will, however, be repaid every six months in saving; and as this needs little fixing, it may be taken about as easily as ordinary furniture in case of removal.

Owing to the irregularity and small quantity of domestic cooking, gas is peculiarly adapted for this work; as the cost is, or ought to be, in exact proportion to the work done. The use of gas for cooking practically compels cleanliness, as, in the absence of proper cleaning of vessels, etc., it is liable to smell. If there is any smell there is something wrong somewhere which needs to be found out and set right. There are some points in gas cooking apparatus which have been overlooked by almost all makers, and to some of these I wish to call your attention. These people who allow, say, a yard and a-half in width to a coal cooking-range expect to do the same work with gas in about one-third the space. They get a make-shift, with one part crowded on top of the other in such a position that they cannot see or quickly get at their work. One thing boils over into the other, and the result is a condemnation of the system, whereas the fault is with the apparatus.

Gas cooking apparatus—ovens, boilers, etc.—should be all on one level, the height of an ordinary table, and one part should not be on top of the other if good work and economy are to be considered. Another point is the use of hot plates for broiling. These may with care be used with fair economy, but in practice they are excessively costly. A burner should be used only for one vessel at once, and should be so arranged that this vessel can only be put directly over it. If it can be pushed sideways when it boils, nineteen servants out of twenty will do this, just as they do with a fire, instead of turning the gas down, and the consequence is that instead of using about two cubic feet of gas to boil a pan of potatoes, they leave the gas full on all the time, and use perhaps 10 or 12 feet to do the same work. If there is no support for the pans except immediately over the flame, a servant must of necessity turn the gas down when a pan boils, or it will boil over and make a mess, which she has the trouble of cleaning up; she is, in fact, compelled to be economical with the gas, whatever her desires or ideas may be. You will understand that in my proposals to alter your system of fires and cookery I do not speak from fancies or new experiments, but from the results actually obtained with both systems of fire for years continuously, and also with different systems of gas cooking for a period extending over the last 18 or 19 years.

Now for the cost. My house contains 12 rooms, with a private workshop at the side, with two fire grates, one being the dirty, expensive luxury which heats the plant-house. I paid, for the 12 months ending June 30 last, £5 17s. for coal for the whole year, and the only chimney I ever see smoke issuing from is the one belonging to the workshop. I have not taken the whole year's gas consumption for cooking and heating; but so far as I have taken it I am quite certain it is decidedly less than £3 for the year. Gas, with us, costs 3s. 6d. per 1000 cubic feet, and coal averages 13s. to 14s. per ton. We limit neither gas nor fire; both are used freely, without stint of our own pleasure and comfort, and I think the figures given prove my case.

I have been asked to give a short practical demonstration of the production of high temperatures with gas. Not to delay you unnecessarily, I will fuse and pour about one pound of steel in this little furnace which I could almost put in my pocket. Starting all cold, I expect to do this in about six minutes. I can remember the time when with the best available apparatus known this would have taken about an hour. It will be noted that to do this I use a blast of air under pressure from a small foot blower. This enables me not only to get enormously high temperatures rapidly, but also admits of absolutely perfect combustion at any speed in a small, close, non-conducting chamber, with no openings except a very small one for the entrance of the burning mixture of gas and air, and a corresponding one for the exit of the products of combustion. I here obtain absolutely perfect combustion under the most perfect conditions possible.

I believe the knowledge of gas fuel used without an artificial blast of air is yet in its infancy, and that we have still very much to learn. It is, I think, certain that a very serious change in our system of burning gas as a fuel is not far distant, and that our present clumsy apparatus will soon give way to a better system. It is quite certain that no gas flame for heating purposes, burning without a blast of air, is perfect in all points, and the perfect burner has yet to be discovered.—*Journal of Gas Lighting.*

Dangers of Electricity.

The New York *Evening Post*, of January 25th, contains an account of the new rules adopted by the Board of Fire Underwriters concerning electric wires. The capacity of conducting wires was considered, and for arc lights it was stipulated that the conductor must have a weight per running foot at least equal to that of the wire (or parallel group of wires) constituting the main circuit of the magnetic regulator of the electric lamps, or of the armature of the machine employed, whichever of these is the largest.

For incandescent lights the conducting wires must be large enough never to grow unpleasantly warm to the touch. In no case must electric wires be connected with the earth, or with gas or water pipes running to the earth.

Exposed wires must be covered with two coatings, and where there is exposure to water one of these coatings must be waterproof. At the point where electric wires enter a building a switch or "cut-out" must be provided, so that in case of fire there will be no danger to the firemen. The outgoing and returning wires for arc lights should enter and leave a building at points at least one foot from each other.

In running along walls or ceilings the wires of an arc lamp should not be nearer than eight inches from each other; for incandescent lights two and a half inches' distance is sufficient. Wherever wires are carried through walls, floors or partitions in buildings, they must be surrounded by a special insulating tube of substantial material. Arc lights must be protected by glass globes, enclosed at the bottom to prevent the fall of ignited particles, and where inflammable materials are present below the lamps, a wire netting must be added to keep the parts of the globe in place in case of its fracture during use. Wherever a current of such high electro-motive force is employed that, if concentrated on one lamp of the series, it would produce an arc capable of destroying or fusing parts of such lamp, an automatic switch must be introduced in each lamp by which it will be thrown out of circuit before the current approaches any dangerous intensity.

Watertight Brick Walls.

[The following appears in the *Sanitary Engineer*, and is of interest to those building tanks.—Ed.]

Some of the mechanical journals are publishing as novel a method of rendering brick work impervious to moisture by the application of a soap and alum wash. The recipe is good enough to be recalled to the attention of engineers and architects, but it should not be put forth as new. It has been known in England for at least twenty years as "Sylvester's process," and was successfully applied to the interior walls of the gate houses of the Croton reservoir in the Central Park in this city, in 1863, on the advice of the late William Dearborn, C.E., and under the immediate supervision of George S. Greene, Jr., C.E., now the Engineer in Chief of the Department of Docks.

The process and its results in this case, are described fully by Mr. Dearborn in a paper read by him before the American Society of Civil Engineers May 4, 1870, and published in the transactions of the Society as No. XVI., Vol. I., p. 203, from which the following description is condensed:

The process consists in using two washes or solutions. The first composed of ¾-lb. of Castile soap dissolved in one gallon of water, laid on at boiling heat with a flat brush. When this has dried, 24 hours later apply in like manner the second wash of ½-lb. of alum dissolved in four gallons of water. The temperature of this when applied should be 60° to 70°F. After 24 hours apply another soap wash, and so on alternately until four coats of each have been put on. Experiments showed that this was sufficient to make the wall watertight under 40 feet head of water.

At the time of application the walls had been saturated and the weather was cold. The gate chambers were covered over and heated thoroughly with large stoves. The drying, cleaning the walls with wire brushes, and applying the mixture took ninety-six days. Twenty-seven tons of coal were used for the drying and one ton for heating the soap solution. Eighteen thousand eight hundred and thirty square feet of wall were washed with four coats.

The drying and cleaning of the walls cost 6½ cents per square foot, and the plant, materials and labor of applying the wash cost 3⅜ cents per square foot.

From my own notes of the work I take the following, which may be of interest:

Two men using the brushes, with four helpers, laid a wash on 3,766 square feet per day. For every 1,000 square feet of surface there was needed for each coat of the mixture 6¾ lbs. soap and 2¾ lbs. alum. The cost of the soap and alum was 13 per cent. of the total cost of the work, not including the drying by stoves and cleaning the wall. For application to a clean wall the cost would be made up thus—soap and alum, 18 per cent.; labor 23 per cent.; scaffold and tools, 19 per cent.; superintendence 15 per cent.

J. J. R. Croes.

The Spectra of Sunlight, Gas, and Electric Light.

Some weeks since a question was put by a correspondent in *Nature*, with the obvious intention of obtaining confirmation of a statement that the spectrum of the electric light was similar to that of sunlight; the teaching of which correlation would be that, for optical purposes, the electric light was equally good with that of the sun.

In a later number of our contemporary, however, the characteristics of the spectra of sunlight, electric light, and gas flames are explained by Mr. J. Rand Capron, but not precisely in the way desired by the querist. While admitting that the relative effect of the "sun-s golden glare, the gas flame's duller yellow light, and the electric light's moon-like whiteness," on the optic nerve, have not been scientifically determined, Mr. Capron recognizes the fact that popular opinion assigns injurious results to the whiter light. He also states that the illuminating portion of a gas flame presents in the spectroscope the appearance of a dull sun spectrum, without the dark lines. This is equivalent to placing the illuminating gas flame in closer approximation to the sun's light, for optical purposes, than it is possible to claim for the electric arc light.

It is evident that the spectroscopic examination of high power gas flames should now be undertaken with a view to determining the differences which such flames present when compared with the flame of the ordinary small burner.—*Journal of Gas Lighting.*

Correspondence

[The JOURNAL is not responsible for the opinions expressed by correspondents.]

Stopped Standpipes.

To the Editor AMERICAN GAS LIGHT JOURNAL:

In the *Journal of Gas Lighting*, of January 10, 1882, is a communication from Mr. G. E. Stevenson on the "Dieterich Furnace." In concluding he says: "Wherever the generator system has been introduced the increase of temperature has been followed by stopped pipes," and he gives what he believes to be remedies therefor. 1st, thick, hollow front walls; 2d, large size wrough iron ascension pipes; 3d, use valves instead of dip pipes, and separate the tar and gas on leaving the ascension pipes. Now, while I do not use any generator furnace (but soon shall), I burn tar in winter and, whenever I do so, my heats will go up so as to stop ascension pipes, just as Mr. Stevenson states; yet I use thick, hollow walls in front of bench, have used large, wrought iron ascension pipes for over seven years, used anti-dip and dip-seal, separated the gas and tar, have tried Mr. Wood's plan of a stream of water inside and outside of pipes, but still high heats will stop pipes. The past two winters I have used, on part of my retorts, a sub-mouthpicce that removes the ascension pipes six inches further out from bench. So far it helps, though stoppages are not unknown, they are fully 80 per cent. less. I have only one stopped pipe where the sub mouthpiece is used to five in bench without them.

Yours,

ROCKFORD, Ill., Jan. 27, 1882. THOMAS BUTTERWORTH.

The New Gas Works at Jamestown, N. Y.

ALBANY, N. Y., Jan. 10, 1882.

To the Editor AMERICAN GAS LIGHT JOURNAL:

There are some points connected with the construction and management of these works of sufficient interest to the profession to warrant a brief description in the columns of the JOURNAL.

The old and utterly inadequate works of the Jamestown Gas Light Company were purchased in the Spring by A. F. Kent & Co., of Oil City, Pa., and they proceeded at once to erect new works, the designs for which were furnished, and the entire work done, under the supervision of Mr. A. F. Kent himself.

The site selected was in some respects a most unpromising one, it being composed, for the most part, of a steep side-hill, terminating at the bottom in a swamp. Yet, in the construction of the works, even these adverse conditions were turned to advantage.

I recently had the pleasure of examining the works, and was impressed with the beauty of the buildings, which are constructed of pressed brick—tasteful in design, large, beautifully lighted and thoroughly ventilated; and in them, as well as in all the appliances for the manufacture of gas, there is evident and adequate provision for largely increased consumption. When a contemplated new holder is erected they will have a capacity of 125,000 cubic feet per diem. From present indications even this large figure is likely to be reached in the near future. The output even now is nearly half that amount, and is rapidly increasing.

In building both the retort and purifying houses Mr. Kent wisely availed himself of the sloping nature of the ground to construct roomy and well-lighted basements under each, accessible to carts, and furnishing abundant storage for coke, etc. Also, providing facilities for the erection of benches on the regenerating plan employed by Mr. Livesey in the South Metropolitan Works in London.

There are arches for four benches of "fives," only two of which are occupied. One of these has been in use about seven months with the most satisfactory results. The heats are simply beautiful, easily controlled, and both retorts and settings are unimpaired. The indication being that the duration of the bench would exceed the average lifetime of benches fired in the ordinary way.

The yield with Youghiogheny coal averages nearly five feet to the pound of coal. The precise candle power could not be determined, Mr. Kent having only an unreliable jet photometer, which gave the gas a much higher rating than it deserved, excellent though it was.

With a consumption of 50 bushels of coke Mr. Kent finds no difficulty in obtaining 40,000 feet per diem from it. He finds no trouble from choked standpipes, or from deposits of pitch, etc. In fact, his experience with this bench, and also with one more recently fired up, seemed to demonstrate the superiority of gaseous over solid fuel for heating benches.

The surplus coke is crushed in the retort house and passes through a trap in the floor, and over a seive, into the basement below.

The works are supplied with a rotary exhauster, multitubular condenser, and a large and very effective coke scrubber. For purification Mr. Kent prefers the oxide of iron, with a little lime for the removal of carbonic acid, and, as the boxes are large, the gas is exceptionally pure.

Upon taking charge of the works Mr. Kent issued a circular setting forth the policy which would control the company in their dealings with their customers, and giving valuable information upon many points connected with the use of gas, and, in various ways, suggesting an identity of interest between the manufacturer and consumer.

The price was at once reduced to the following very low figures:

1,000 feet or less per month	$2 50
1,000 feet to 5,000 feet per month	2 25
Over 5,000 " "	2 00

A discount of ten per cent. is allowed on all bills paid within the first five days of the month.

Now, mark the result. Within six months from the time the new company took charge of the business the consumption more than doubled! True, some of this increase was due to improvement in trade generally; but by far the greater part must be credited to wise management—the furnishing of a full supply of gas of an excellent quality, at a reasonable price, and in so conducting their business as to merit, and eventually to win, the confidence of consumers.

It seems peculiarly fitting that this beautiful village, "the gem of Chatauqua," with its handsome churches, excellent hotels, and thriving industries, should be able to boast of one of the best constructed and most admirably managed gas works in the country. SARGENT.

The Effect of Passing an Electric Spark through Coal Gas.

LABORATORY LONDON GAS LIGHT CO.,
NINE ELMS, LONDON, ENG.,
January 11th, 1882.

To the Editor AMERICAN GAS LIGHT JOURNAL:

I observe in the Number for January 2d of your valuable JOURNAL, a quotation from the *Engineer*, in which you say that it has been recently announced that, by passing the electric spark through coal gas, its volume may be doubled, and also its illuminating power. It will, I think, be obvious to all chemists that this statement requires correction, because if the volume be doubled even assuming no carbon to be deposited, it is quite impossible for the illuminating power to be doubled also. With regard to the production of acetylene, by "sparking" the various constituents of coal gas, this is a very old affair; Bertbelot, Greville, Williams, and, I believe, several other chemists, having occupied themselves with the question. The assertion, which you quote, that acetylene contains less carbon than any other hydrocarbon known, is entirely erroneous, as, in fact, it contains the same quantity of carbon as benzine, almost as much as naphthaline, and far more than marsh gas, as may be seen by a comparison of the following numbers:

	Acetylene.	Benzine.	Naphthaline.	Marsh Gas.
Carbon	92.31	92.31	93.75	75.00
Hydrogen	7.69	7.69	6.25	25.00
	100.00	100.00	100.00	100.00

Acetylene, I may mention, is always spelled as above. An investigation upon the effect of the induction spark upon coal gas is being made in the laboratory of the London Gas Light and Coke Company at the present time; but I am not yet at liberty to state with what results. I hope, however, before long to send you a communication on the subject.

Yours faithfully,

HAMILTON DOVE.

Suffocated by Gas.

To the Editor AMERICAN GAS LIGHT JOURNAL:

"Christina Vedell, a servant aged twenty-three, but partially turned off the gas in her room Tuesday night and was found dead in Professor George L. Westgate's house in Middletown yesterday morning."

The above item I cut from a Connecticut paper of December 8th. Middletown, Conn., is a place containing some 1200 inhabitants, the gas company there may have 600 consumers. Gas works were established there some thirty years ago, and, up to one year ago last September, the gas distributed was made from coal. Up to that time there is no record of any death caused by inhaling gas, outside of the gas works. In September, 1880, the Middletown Gas Company began to distribute "water gas." In the December following a servant girl at the Insane Asylum was found dead in her room from inhaling gas. In July last a guest at the principal hotel of the place was found dead in his room from the same cause, and in December, of last year, we have the above record, making three lives lost since the company changed theis process of manufacture in September, 1880. There are some fourteen gas companies in the State of Connecticut, and some of them are works of considerable size, for instance, those of Hartford, New Haven and Bridgeport. I believe there is no record of any death caused by inhaling gas, outside the works, up to September, 1880.

In conclusion, I would say that the above facts show the wisdom of the legislation of Massachusetts, which restricts the carbonic oxide in commercial gas to 10 per cent. of its volume.

Truly, yours,

OBSERVER.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

Editor—G. WARREN DRESSER.
Manager—C. E. SANDERSON.

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THURSDAY, FEBRUARY 2, 1882.

Patents.

251,416. Carbureting apparatus.—G. W. Crowell.
251,436. Gas pressure regulator.—Robt. F. Hatfield.
251,458. Fuel, and process of manufacturing the same.—Geo. Shepard Page.
251,673.—Carburetor.—Wm. T. Barry.
251,711. Combined shade and concentrator for artificial light.—J. S. Goldsmith & H. H. Smith.
251,712. Concentrator for artificial light.—J. S. Goldsmith and H. H. Smith.
251,777.—Electric gas lighter.—C. D. Haskins.
251,822. Gas regulator.—L. P. Blair.
251,864. Gas governor.—N. M. Garland.
252,001. Pipe joint.—J. K. Dimmick.
252,038. Apparatus for unloading coal.—Wm. Ilett.
252,473. Manufacture of dinitro-benzole from gas obtained by distillation of coal.—J. A. Kendall.
252,503. Method of and apparatus for the manufacture of combustible gas.—N. A. Ootto.

REISSUES.

10,008. Chandelier.—C. F. Jacobsen.

Electricity as a Motive Power.

An interesting lecture has been given by Mr. W. Lachlan, C.E., on the "Secondary Battery." Successful results, he premised, had been obtained in lighting a train experimentally with electricity on the Brighton line. Referring to the electric railway at Berlin, and the electric tram car in the Place de la Concorde, he stated that tram cars could be propelled by electricity in accumulators at one-third less cost per diem than horse power, irrespective of the capital sunk in the purchase of horses at £40 each. He had worked a sewing machine from an electric accumulator, and he saw no reason why trains should not be run by the same force on the Underground Railway without any locomotive whatever. Mr. Applegarth, fully indorsing the remarks of the lecturer, expressed his opinion that the forthcoming electric exhibition at the Crystal Palace will far excel that held in Paris. Thanks were given to the lecturer for his very able paper. In response he said that cells had already been prepared to prevent gyration in balloons.—*Times*.

ACCIDENT TO CITIZENS GAS WORKS, NEWARK.—During the snow storm of Jan. 31st the holder of this company was upset about 9 P.M., so that the gas escaped from it and took fire. The portion of the city lighted by the company was left in darkness. Full particulars are not at hand at time of going to press.

Gas Stocks.

Quotations by G. W. Close Jr., Broker and Dealer in Gas Stocks.
(with W B Scott & Co.,)
34 PINE STREET, NEW YORK CITY.

FEBRUARY 2, 1882.

☞ All communciations will receive particular attention ☜ The following quotations are based on the par value of $100 per share.

	Capital.	*Par.*	*Bid.*	*Asked*
Gas Co.'s of N. Y. City.				
Central	$466,000	50	70	75
Harlem	1,800,000	50	93	95
" Bonds	170,000			103
Manhattan	4,000,000	50	225	230
Metropolitan	2,500,000	100	160	165
" Bonds	658,000	..	107	110
Mutual	5,000,000	100	95	100
" Bonds, go'd.	900,000	1000	100	104
Municipal	1,500,000	100	200	205
" Bonds	750,000		106	110
New York	4,000,000	100	120	125
Northern	270,000	50	—	100
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	112	116
Citizens	1,200,000	20	55	60
" S. F. Bonds.	320,000	1000	105	109
Fulton Municipal	1,500,000	100	70	75
Peoples	1,000,000	10	30	35
" Bonds	290,000	.	101	104
" "	250,000	...	70	75
Metropolitan	1,000,000	100	70	75
Nassau	1,000,000	25	60	65
" Ctfs.	700,000	1000	95	100
Williamsburgh	1,000,000	50	70	75
" Bonds	1,000,000	...	98	103
Richmond Co., S. I.	300,000	50	70	75
" Bonds	40,000	—	—	—
Out of Town Gas Companies.				
Buffalo Mutual, N.Y	750,000	100	72	76
" Bonds	200,000	1000	95	100
Citizens, Newark	918,000	50	85	90
" " Bds.	124,000	—	105	10
Chicago Gas Co., Ills			125	—
Cincinnati G. & C. Co.			178	180
Consolidated, Balt.			38	39
Bonds			107	—
East Boston, Mass		25	114	120
Hannibal, Mo	100,000	100	95	100
Hartford, Conn	700,000	25	140	144
Halifax N. S	400,000	40	148	150
Hamilton, Ontario	135.000	40	117½	
Jersey City	750,000	20	155	160
Jacksonville, Ill	120,000	50	100	...
Lewistown Maine	400,000	100	—	100
Laclede St Louis Mo.	1,200,000	100	108	110
Montreal, Canada	2,000,000	100	159	160
New Haven, Conn		25	132	—
Oakland, Cal			32	33
Peoples, Jersey City		...	75	80
" " Bds.				5
Pittsfield, Mass			120	130
Rochester, N. Y		50	70	80
" Citizens		100	80	85
Wilmington, Del		50	174	...
Yonkers		50	30	32
St. Louis Missouri	600,000	50	250	254
San Francisco Gas Co., S. Fr'isco Cal.			68	69
Toledo, Ohio			95	97
Troy, Citizens	600,000	100	—	—
Washington, D. C	1,500,000	20	185	200
" Scrip	375,000	15	200	206

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"The best evidence of what I think of it is that I have recommended our Board to purchase one and have it erected in our works during the coming summer."—JOHN H. MCELROY, Pittsburgh, Pa.

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"I was at Beckton last week. Four of the six "Standards" were at work, and the other two shortly to be put in use, as the make increases; *while ten tall tower-scrubbers stand idle alongside.*—Letter from London, Oct. 25, 1881.

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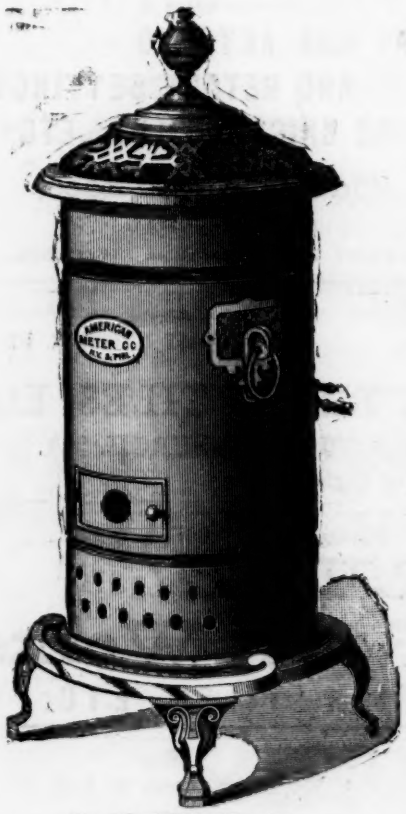

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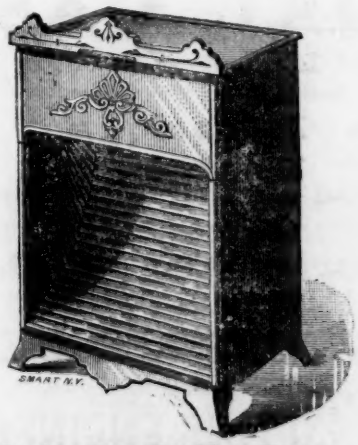

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No. 17.—Open Fire-Place Heater.

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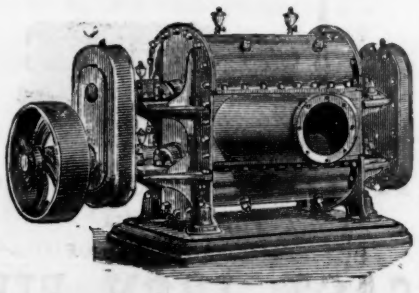

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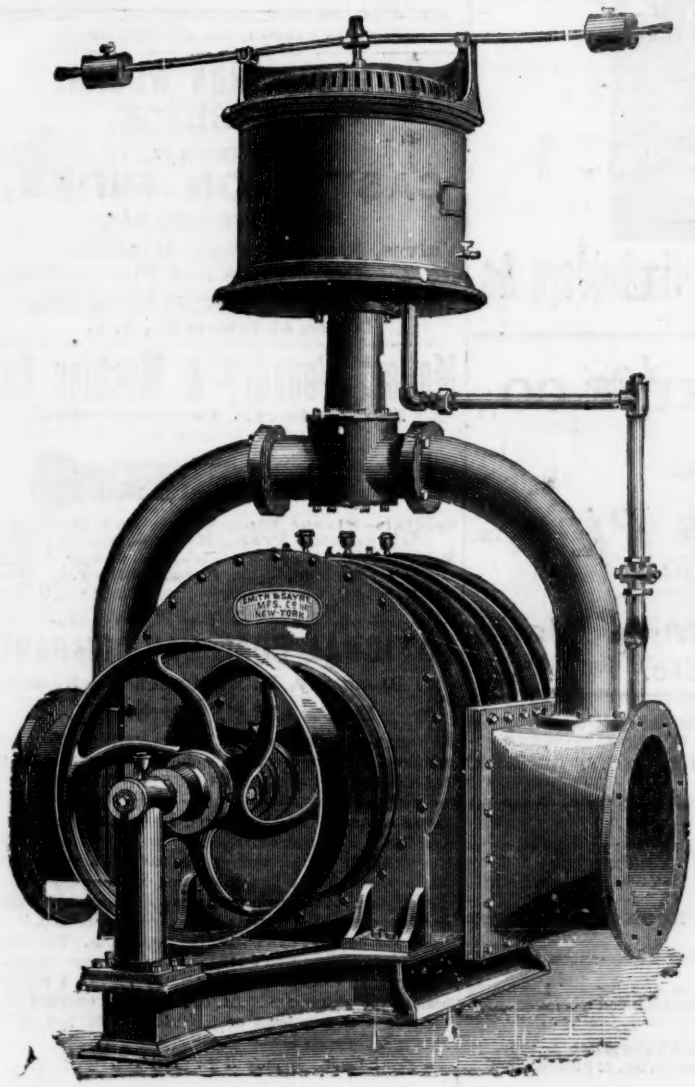

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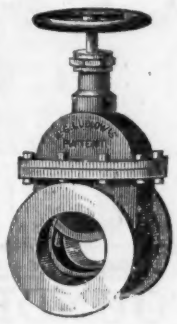

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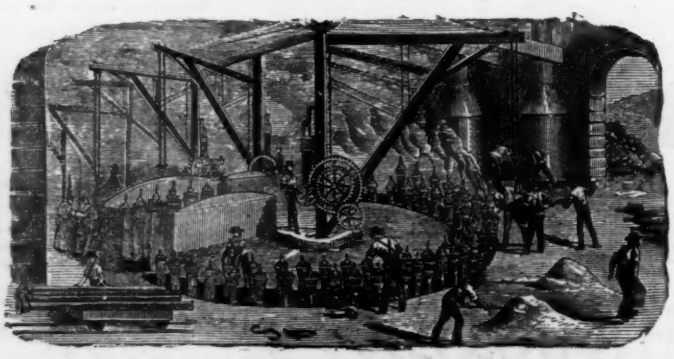

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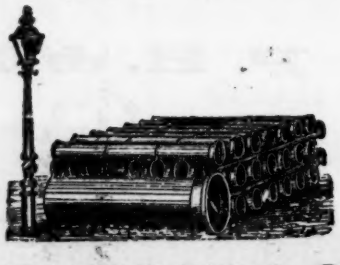

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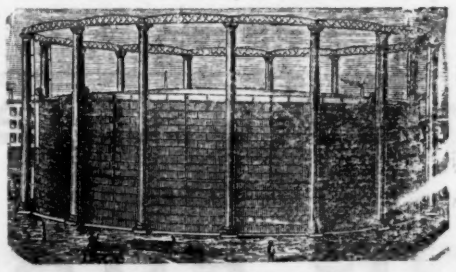

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THE AMERICAN

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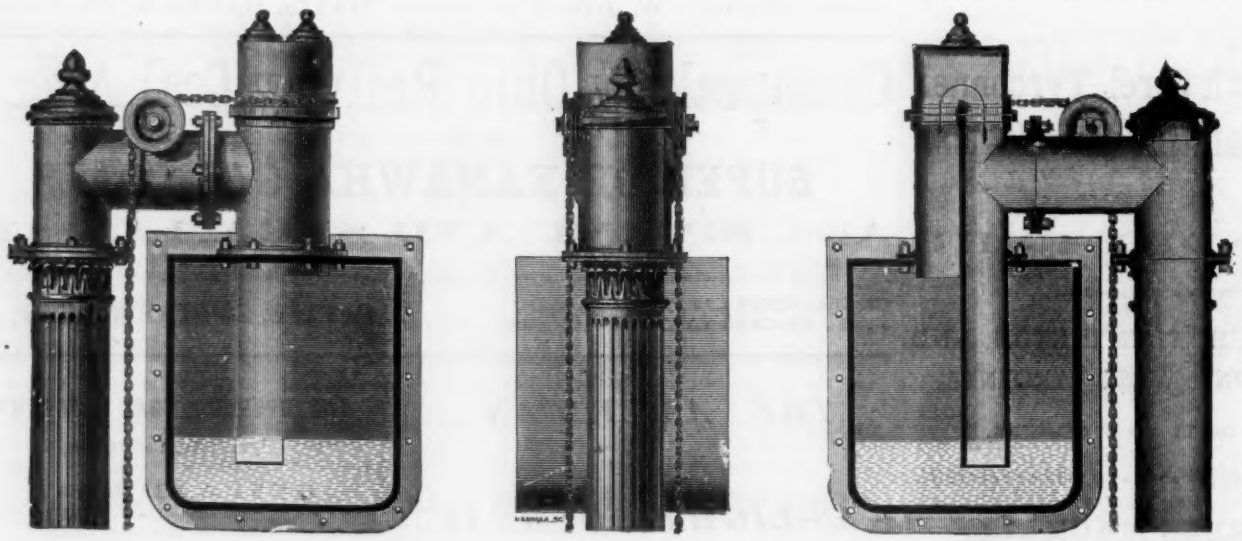
Attest—J. L. CAMPBELL, Secretary, pro-tem. Signed—A. T. GOSHORN, Director General J. R. HAWLEY, President

FARMER'S PATENT

BYE-PASS DIP-PIPE.



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PATENT FLAT-FLAME BURNERS

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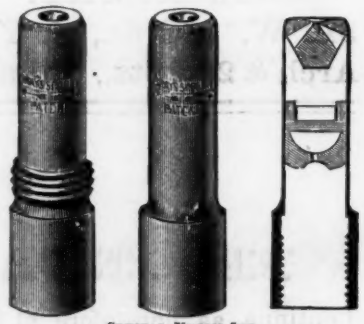

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The Special Burners are made for both High and Low Pressure. In ordering Burners our customers will confer a favor by stating the Pressure.

Bray's Patent Standard Slit-Union Burners do not Corrode in any Atmosphere.

They give a Permanently Well-shaped Flame, free from Roaring and Flickering.

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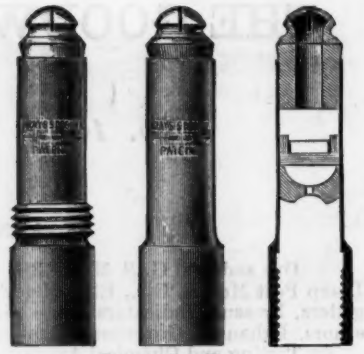

SPECIAL SLIT-UNION.

The "Special" Burners, as improved, are more adaptable to the requirements of gas illumination than any now before the public. They can be made to suit any pressure or quality of gas (including air gas). The gas inlet is so placed that it cannot be tampered with, and they are not liable to get out of order.

The following table and sentences in quotation marks are taken from the report of S. C. Ford, the United States Inspector of Gas and Meters at Washington, D. C., for the year 1881:

Description of Burner.	Pressure at points of ignition.	Actual consumption of gas per hour.	Illuminating power in candles at rate of actual consumption.	Illuminating power in candles, at rate of 5 cu. ft. per hour.	Value of one foot of gas in terms of standard candles.
	Inches.	Cubic Feet.	Candles.	Candles.	Candles.
Bray's Standard Slit-Union (30 candles....	.255	6.90	30.04	21.76	4.35
" Special Slit-Union No. 7.....	.50	4.74	19.20	20.25	4.05
" " " No. 6.....	.50	4.10	16.61	20.25	4.05
" " " No. 5.....	.50	4.24	16.97	20.01	4.00
" " " No. 4.....	.60	3.49	12.58	18.02	3.60
" " Union Jet No. 7.....	.50	4.84	19.13	19.76	3.95
" " " No. 6.....	.55	4.32	17.10	19.79	3.95
" " " No. 5.....	.60	4.14	15.65	18.90	3.78
" " " No. 4.....	.55	3.38	12.04	17.81	3.56
" Regulator Union Jet No. 7.....	.50	4.99	17.69	17.72	3.54
" " " No. 6.....	.50	5.18	17.63	17.01	3.40
" " " No. 5.....	.60	4.37	13.71	15.68	3.13
" " " No. 4.....	.60	3.97	11.46	14.43	2.88

"On examination of the above table of tests, made with various burners, it will be observed that the illuminating power obtained with Bray's special burners Nos. 5, 6, and 7, both slit-union and jet form, was high; but with Bray's regulator burners only moderately good."

"The result of test with Bray's standard slit-union burner was highly satisfactory. This burner is best suited for street illumination, and will yield the maximum power obtainable from a cubic foot of gas."

"The special burners manufactured by Bray & Co. compare favorably with any yet inspected by this office. They are well made, and no doubt will prove very durable in practical use. They are best adapted for gases of high gravity."

Bray's Patent Standard Slit-Union Burners are of 30, 40, 50, 60, 70, and 80 candle power. The Patent Lanterns are adapted for burners of 50, 80, 100, 200, 300, 400, and 800 candle power, and are acknowledged to be the best lantern for street lighting yet invented. Price Lists and Circulars furnished on application.

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